PB81-910221

U.S. DEPARTMENT OF THE INTERIOR

OFFICE OF WATER RESEARCH AND TECHNOLOGY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 14, NUMBER 21
NOVEMBER 1, 1981

W81-05001 -- W81-05350
CODEN: SWRABW

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A semimonthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

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Miami Univ., FL. Div. of Marine and Atmospheric Chemistry; and Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2K.
W81-05196

2. WATER CYCLE

2A. General

EVALUATION OF AGRICULTURAL BMP ALTERNATIVES WITH THE FINITE ELEMENT STORM HYDROGRAPH MODEL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W81-05007

DATA-BASE SYSTEM FOR NORTHERN MIDWEST REGIONAL AQUIFER-SYSTEM ANALYSIS,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05019

SURFACE HYDROLOGY: V--IN-SURFACE TRANSIENT FLOW,
Technion-Israel Inst. of Tech., Haifa.
D. Zaslavsky, and G. Sinai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 65-93, January, 1981. 20 Fig, 4 Tab, 9 Ref.

Descriptors: *Subsurface water, *Rainfall-runoff relationships, *Runoff, *Rainfall infiltration, Horizontal flow, Hydrology, *Surface runoff, Erosion, Infiltration, Puddling, Soil water, Slopes, Flow characteristics.

The numerical computation of nonsteady flow through the surface transition layer is the subject of the final report in a series on surface hydrology. The numerical solutions have been used as methods of experimentation to study the influence of the slope, the curvature, the rain regime, and the thickness of the transition layer on the flow regime. Many of the conclusions have been mentioned in the previous four reports. Additional conclusions are: (1) a slight, uphill flow component, normal for the wetting front, can occur in the early stage of a rainfall, (2) no moisture accumulates in concave spots in a uniform soil during the rainfall time, (3) after saturation occurs in the transition zone, it can approach the upper part of the transition layer as seepage, and (4) seepage can produce erosion and runoff along the soil dip. (Cassar-FRC)
W81-05092

APPLICATION OF ERROR ANALYSIS TO A MARCH HYDROLOGY MODEL.
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. H. Gardner, D. D. Huff, R. V. O'Neill, J. B. Mankin, and J. Carney.
Water Resources Research, Vol 16, No 4, p 659-664, August, 1980. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Marshes, *Hydrologic models, *Error analysis, Model studies, Monte Carlo method, Water level, Mathematical models, Water storage, Marsh hydrology.

Error Analysis of a march hydrologic model considered the contribution of errors in individual parameters to uncertainties in model predictions. Errors associated with each parameter (precipitation, storm runoff from the urban watershed, soil physical properties, groundwater movement, and evapotranspiration) were propagated through the model calculations by Monte Carlo simulation. This model prediction was more accurate than simpler nonlinear models, but errors were still significant. Water level can be predicted within 40%, with maximum errors exceeding 90% of the mean on some days. Seasonal variations must be considered in model calibration and validation, since different mechanisms dominate model behavior from season to season. Results from the Monte Carlo analysis differed from those by sensitivity analysis. (Cassar-FRC)
W81-05135

A MODEL TO FORECAST SHORT-TERM SNOWMELT RUNOFF USING SYNOPTIC OBSERVATIONS OF STREAMFLOW, TEMPERATURE, AND PRECIPITATION.
Geological Survey, Tacoma, WA.
W. V. Tangborn.
Water Resources Research, Vol 16, No 4, p 778-786, August, 1980. 14 Fig, 2 Tab, 10 Ref.

Descriptors: *Snowmelt, *Stream discharge, *Runoff forecasting, Precipitation, Air temperature, Model studies, Mathematical models, Streamflow.

Snowmelt runoff is forecast with a statistical model that uses daily values of stream discharge, gaged precipitation, and maximum and minimum observations of air temperature. It is designed chiefly for short season (1 to 15 days) forecasts, but it may also be applied for longer seasons (several months). Observations may be made at existing low- and medium-altitude weather stations. Four model development steps are used to show the influence on prediction accuracy of basin storage--selection of representative gaging stations, a preforecast test season, air temperature indexes, and final adjustment of streamflow projections based on the first three steps. The model was tested by a split sampling technique for the 1960-1977 period in four basins representing diverse hydrologic and climatologic regimes in the western U.S. Coefficients of prediction based on actual, short-term predictions for the 18 year period were: Thunder Creek, Washington, 0.69; South Fork Flathead River, Montana, 0.45; Black River, Arizona, 0.80; and Kings River, California, 0.80. This model may be improved by (1) consideration of the movement and storage of liquid water within the snowpack and (2) separation of the basin into separate hydrologic units. (Cassar-FRC)
W81-05138

ADAPTIVE FILTERING THROUGH DETECTION OF ISOLATED TRANSIENT ERRORS IN RAINFALL-RUNOFF MODELS.
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
P. K. Kitanidis.
Water Resources Research, Vol 16, No 4, p 740-748, August, 1980. 5 Fib, 1 Tab, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Discharge hydrographs, *River forecasting, Error analysis, Mathematical models, Model studies, Runoff.

An adaptive filter was developed to minimize transient errors in real-time river discharge forecasting models during storm events. It corresponds to a more realistic uncertainty model than do the Kalman and other commonly used filters. This filter operates normally under the assumption of only stationary of slowly varying noise, and a generalized liklihood ratio test is used to detect transient errors. The adaptive methodology was applied to river discharge for the Cohocton River basin, New York, during January 1970. The measured and predicted results were very similar, whereas the Kalman filter produced low results during the last six days of the month when river discharge was high. (Cassar-FRC)
W81-05140

STATE VARIABLE MODEL FOR URBAN RAINFALL-RUNOFF PROCESS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Bulletin, Vol 17, No 2, p 181-189, April, 1981. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Runoff, Urbanization, Hydrologic models, Urban runoff, Urban hydrology, Rainfall, Water resources development, Computers, Mathematical models.

A nonlinear hydrologic system model is described, which is based on the concepts of state variable modeling and shows the model's applicability for analyzing the hydrologic effects of urbanization of a watershed. The hydrologic system is assumed to be represented by a lumped, time invariant, nonlinear system. A search technique is employed to find the set of parameters for which the model's response best fits observed data. The model could be used in either a simulated or a forecasting mode. The model is applied to observed data for the Waller Creek Watershed in Austin, Texas, to develop the model parameters for various levels of urbanization of the watershed. The trend of each parameter with respect to levels of urbanization is examined. State variable modeling provided a generalized framework within which many different kinds of system models can be expressed and combined for the representation of a given system. Linear or nonlinear, time variant or time invariant, deterministic or stochastic systems with multiple inputs and outputs may be modeled by this approach. Its application to the analysis of water resources systems is relatively recent. (Baker-FRC)
W81-05166

A SIMPLE PROCEDURE FOR DEVELOPING A DESIGN STORM HYDROGRAPH.
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. Ward, T. Bridges, and B. Wilson.
Water Resources Bulletin, Vol 17, No 2, p 209-214, April, 1981. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Storms, *Hydrographs, Watersheds, Computers, Rainfall-Runoff relationships, Design criteria, Mathematical studies, Runoff, Hydrologic models, *Model studies, *Design storms, Streamflow forecasting, Peak discharge.

A simple method was developed for predicting peak discharge rates and for developing a storm hydrograph. The method was developed based on simulation studies with a complex computer model, WASHMO (Watershed Storm Hydrograph-Multiple Option). The methods were developed by conducting a regression analysis with simulated data. A brief description of the model is presented, together with the results of a verification study with the model. The model is based on Soil Conservation Service (SCS) procedures, but also incorporates a double triangle hydrograph method for use in agricultural and forested watersheds. The regression procedures provide a simple hand calculator method for generating a storm hydrograph. The simple procedure appears suitable for estimating peak discharges for use in designs where the exact shape of the runoff hydrograph is not critical. It is felt that the main value of the procedure lies in the development of initial designs which will be used with more complex computer procedures. The FLASH equations presented are rational and have been developed for a wide range of watersheds and storm conditions. If these equations are to be used in conjunction with other hydrologic methods, it may be necessary to incorporate a calibration factor in the equations. (Baker-FRC)
W81-05172

USING A DISTRIBUTED ROUTING RAINFALL-RUNOFF MODEL.
National Space Technology Labs., NSTL Station, MS.; and Geological Survey NSTL Station, MS. Gulf Coast Hydroscience Center.
W. H. Doyle, Jr.
Water Resources Bulletin, Vol 17, No 2, p 225-232, April, 1981. 5 Fig, 4 Tab, 4 Ref.

Group 2A—General

Descriptors: *Rainfall-runoff relationships, *Model studies, Mathematical models, Runoff, Rainstorms, Precipitation, Rainfall, Storms, Rainfall simulators, Cloudbursts, Storm water, Urbanization, Watersheds, Flow rates.

The purpose of this report is to present calibration and verification flow modeling results for 328 storms. Sample water was collected from these storms from four catchments near Miami, Florida. The four sampling sites included an area in a single family residential section, a highway area, a commercial area, and a multifamily residential area. The rainfall-runoff data was for the period January 1974 to June 1978. All the data were recorded at 36 second intervals, and data for 328 storms were digitized and entered into a specially created data management system. The quality of the data was in general very good. However, two problems were encountered. First, the discharge rating in the sewer pipe constriction at the outlet for the transition between open channel flow and pressure flow was not well defined; and second, delineation of contributing drainage areas was questionable due to the flat topography. The study demonstrated that an acceptable calibration and verification of the urban planning watershed model developed by Dawdy, Schaake, and Alley (DSA model) can be achieved with adequate data. With a better representation more typical of overland flow segments like the Miami sites, equal or better results could be obtained. Further research pertains to modifying the model to accommodate water quality transport and different flow computation options depending on a particular mathematical algorithm selected by the user. (Baker-FRC)
W81-05173

MOVING BOUNDARY NUMERICAL SURGE MODEL CLOSURE,
Oak Ridge National Lab., TN.
G. T. Yeh, and F. K. Chou.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW1, p 34-36, February, 1981. 1 Fig, 9 Ref.

Descriptors: *Flood forecasting, *Flood spreading, *Mathematical models, *Water boundary, Storm surges, Surges, Moving boundary.

A discussion is presented of a discrete moving boundary surge model. The model was originally presented to demonstrate the inadequacy of using the conventional fixed boundary models for flood insurance studies by applying the discrete moving boundary model to both prototype and hypothetical problems. The continuous moving boundary simulation would be a great improvement over the discrete moving boundary analysis if the computational algorithm could be successfully used. There may be difficulties with continuous moving boundary simulation. Continuous movement of the node may distort the element to such an extent as to cause numerical instabilities, since the inundation of storm surges usually takes place in tens of kilometers. (See W80-01456) (Small-FRC)
W81-05319

2B. Precipitation

PRECIPITATION MINUS EVAPORATION DATA FOR LAGOON DESIGN AND MANAGEMENT IN THE CENTRAL AND SOUTHEASTERN UNITED STATES.
Missouri Agricultural Experiment Station, Columbia.
H. F. Mayes, and R. M. George.
Transactions of the ASAE, Vol 24, No 2, p 456-458, March-April, 1981. 8 Fig, 6 Ref.

Descriptors: *Precipitation, *Evaporation, *Farm lagoons, Lagoons, Water pollution prevention, Animal wastes, Farm wastes, Maps, *Waste treatment, Probability distribution.

Seasonal values for precipitation minus evaporation were plotted on maps to aid in design and management of livestock waste lagoons. Isolines with increments of 25 cm depict the precipitation minus evaporation at the 10, 50, and 90% probability levels for the winter months (either November-March or November-April, depending on location), the summer months (May-October or April-October), or sping (April-June). Data was based on National Weather Service records from 1930 to 1979 at 78 locations in 20 states. These maps indicate when water must be added to a lagoon in the case of a dry season or when excess liquid must be removed to prevent overflow and subsequent water pollution. (Cassar-FRC)
W81-05127

FREQUENCY OF DRY DAY SEQUENCES.
Science and Education Administration, Beltsville, MD. Hydrology Lab.
D. M. Hershfield.
Water Resources Bulletin, Vol 17, No 2, p 317-320, April, 1981. 5 Fig, 9 Ref.

Descriptors: *Climatology, *Drought, Water resources development, Weather, Seasonal variation, Water supply development, Rainfall, Net rainfall, Precipitation, Frequency analysis, Frequency distribution, Mathematical studies.

The primary objective of this paper is to provide some insight into the drought climatology of the United States by analyzing the long dry periods on a probability basis. Daily data from 100 stations formed the basis for this climatological investigation. Data from nine of the stations averaged about 50 years in length, and the rest were for 20 year periods. Maps are presented showing the magnitude of the two-year, dry day sequences for one mm threshold and the coefficient of variation of the items used in the extreme value analysis. The average coefficient of variation for dry periods for the United States is 30%, compared with that for maximum 24 hr. rainfalls, which is 37%. Such information is useful for long range planning for water resources development and utilization. A future effort to compute seasonal probabilities of dry period sequences using longer records than those used in this study, is suggested. (Baker-FRC)
W81-05178

PRECIPITATION CHEMISTRY PATTERNS: A TWO-NETWORK DATA SET,
D. H. Pack.
Science, Vol 208, No 4448, p 1143-1145, June, 1980. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Precipitation, *Data collections, *Rainfall, Rainstorms, Acid rain, *Chemistry of precipitation, On-site data collections, Data interpretation, Data acquisition, United States, Chemical analysis.

Two seperate network programs were established to monitor precipitation events for their ionic content. The initial four-site program has been expanded to eight locations. The other program involved a nine-site precipitation chemistry network. An attempt has now been made to combine the data from these two networks into a single data set and thus provide a more comprehensive picture of the patterns of the ionic content of precipitation. The sites for the two networks extend from Illinois to Massachusetts and from northern New York to North Carolina. After much review of the data it was determined that precipitation chemistry data, carefully collected and rigidly quality controlled, acquired by different organizations can be intermixed. This combination of data provides a much more comprehensive picture of the patterns than data from either network alone. (Baker - FRC)
W81-05219

ACCESSION AND ORIGIN OF CERTAIN IONS FOUND IN RAINWATER OVER THE INDIAN DESERT,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Soil-Water-Plant Relationship.
R. K. Aggarwal, P. Kaul, and A. N. Lahiri.
Journal of Arid Environments, Vol 3, No 4, p 259-264, 1980. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Rain, *Conductivity, *Ion transport, Chemical composition, Precipitation, India, Deserts, Salts, Seawater, Sodium, Potassium, Calcium, Chloride, Ions, Arid climates, *Indian Desert.

Although the composition of rainwater may be affected by ions from both marine and terrestrial sources, it is often difficult to ascertain the origin of precipitated ions. This study of monsoon rainwater collected at five different stations in the arid and semiarid regions of Rajasthan, India, was designed to obtain information on the ionic concentrations in the rainwater of the different regions in order to explain their origin and to better understand the cycling of salts in the arid ecosystem. Large local and monthly variations were found in the electrical conductivity and in the concentrations of sodium, potassium, calcium, and chloride in samples collected from the different locations over the three-year period. Conductivity values and ion concentrations were generally higher in the rains of June and July compared with those of August and September. The electrical conductivity of the rainwater was significantly and positively correlated with the concentrations of sodium, calcium, and chloride. Chloride was positively and significantly correlated only with sodium, not with calcium or potassium, suggesting that sodium chloride is added to the soil system by rainwater in areas where both sodium and chloride concentrations are high. Calcium was found to be significantly correlated with sodium and potassium, but no significant correlation was noted between sodium and potassium. The ionic concentration ratios of rainwater falling at different stations were not comparable with those of sea water. The absence of any progressive change in ionic ratios with increasing distance from the sea and the lack of similarity of ionic ratios with sea water even at the stations closest to the sea suggest that oceanic influence on rainwater composition is negligible. Terrestrial rather than oceanic salts must, therefore, be the principal source of the ions found in rainfall over the Indian desert. (Carroll-FRC)
W81-05325

2C. Snow, Ice, and Frost

OCEANIC MECHANISMS FOR AMPLIFICATION OF THE 23,000-YEAR ICE-VOLUME CYCLE,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. F. Ruddiman, and A. McIntyre.
Science, Vol 212, No 4495, p 617-627, May, 1981. 9 Fig, 40 Ref.

Descriptors: *Ice-water interfaces, Interfaces, Oceans, Polar regions, *Climatology, Environmental effects, *North Atlantic ocean.

The role of the mid-latitude North Atlantic Ocean in controlling or influencing the earth's climatic history is reviewed. This area of the North Atlantic is situated next to the largest Northern Hemisphere ice sheets of the ice ages. These ice sheets provide a significant local source of moisture for the atmosphere and adjacent continents. The mid-latitude North Atlantic Ocean form a corridor that guides moisture-bearing storms northward from low latitudes, and at times makes direct contact along its shorelines with continental ice masses. Evidence of major ice-ocean-air interactions involving the North Atlantic during the last 250,000 years is reviewed. Mid-latitude ocean temperatures, summer heat storage, winter sea-ice extent, and global sea level were all influenced by the outflow of icebergs and meltwater. The responses of the ocean in turn affect winter moisture flux back to the ice sheets as well as ablation of land ice by calving. The oceanic moisture and sea-level feedbacks, in part controlled by glacial melt products, amplify Milankovitch forcing of the volumetrically dominant mid-latitude ice sheets at the 23,000 year precessional cycle. (Baker-FRC)
W81-05186

2D. Evaporation and Transpiration

FOSSIL DIATOMS AND SCALES OF CHRYSOPHYCEAE IN THE RECENT HISTORY OF HALL LAKE, WASHINGTON,
Hood Coll., Frederick, MD. Dept. of Biology.
C. S. Munch.
Freshwater Biology, Vol 10, No 1, p 61-66, February, 1980. 2 Fig, 16 Ref.

Descriptors: *Lakes, *Diatoms, *Hall Lake, *Washington, Sediments, Cores, Asterionella, Cyclotella, Aquatic life, Eutrophication, Chrysophyta, Fossils.

A core sample of recent sediments was taken on November 5, 1969 under 16 meters of water in Hall Lake, Washington, Besides the fairly diverse diatom assemblages expected, large amounts of siliceous scales and bristles of various species of Synuraceae were noted. Synura and Mallomonas were the dominant genera: Chrysosphaerella, Spiniferomonas, and Paraphysomonas were present in smaller numbers. In the lowermost section of the core the dominant diatom species are Melosira tenella Nygaard and several benthic species of Synedra. At 30-24 cm, Melosira and Synedra continued to be important, but Asterionella formosa increased, followed by Cyclotella stelligera, and Asterionella became dominant. At 23-20 cm, wood fragments and sawdust were found. Centric diatoms were more important here than Asterionella and Synedra. In the 7 cm produced during the period when the lake was meromictic (20-14 cm) Asterionella, Synedra, and Cyclotella were important throughout, with Cyclotella particularly prominent. From 13 cm to the surface the sediment contained a great deal of silt and relatively few microfossils. (Baker-FRC)
W81-05118

EVAPOTRANSPIRATION RELATIONSHIP WITH PAN EVAPORATION AND EVAPOTRANSPIRATION RATIO OF CORN UNDER DIFFERENT NITROGEN LEVELS AND MOISTURE REGIMES,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.
M. Devender Reddy, I. Khrishnamurthy, K.
Anand Reddy, and A. Venkatachari.
Agricultural Water Management, Vol 3, No 3, p 227-231, 1980/1981. 2 Fig, 7 Ref.

Descriptors: *Soil water, *Pan evaporation, *Evapotranspiration, *Corn, Nitrogen, Evaporation, Irrigation, Evaporimeters, Irrigation requirements.

Previous studies have suggested that open pan evaporation may be used to estimate evapotranspiration and irrigation requirements of corn provided that a relationship has been established between evapotranspiration and open pan evaporation for the given area. The results of a 2-year study of the relationship between evapotranspiration and open pan evaporation during the crop growing season under eight nitrogen levels and four moisture regimes are reported. The ratios between evapotranspiration and pan evaporation were low in the initial stages of crop growth and attained maximum values at 70 to 80 percent of the crop growth stage with 20 to 40 percent available soil moisture depletion (ASMD), at 65 percent growth with 60 percent ASMD, and at 55 percent growth with 80 percent ASMD. The evapotranspiration ratio was highest (3573) under no nitrogen and lowest (1312) with 180 kilograms of nitrogen per hectare. The evapotranspiration ratio ranged from a low of 914 with 20 percent ASMD combined with 180 kilograms of nitrogen per hectare to a high of 3954 when 60 percent ASMD was combined with no nitrogen conditions. The 20 percent ASMD regime utilized less water to produce a kilogram of grain than did other moisture treatments. The results demonstrate an additive effect of nitrogen and moisture, indicating that they can be substituted for each other when one of them becomes a constraint. (Carroll-FRC)
W81-05300

2E. Streamflow and Runoff

FLOW ROUTING IN THE SUSQUEHANNA RIVER BASIN: PART IV--ROUTING RESERVOIR RELEASES IN THE EASTERN SUSQUEHANNA RIVER BASIN IN NEW YORK STATE,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4A.
W81-05014

FLOOD POTENTIAL OF TOPOPAH WASH AND TRIBUTARIES, EASTERN PART OF JACKASS FLATS, NEVADA TEST SITE, SOUTHERN NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Christensen, and N. E. Spahr.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.50 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-963 (WRI), 1980. 22 p, 7 Fig, 1 Plate, 4 Tab, 12 Ref.

Descriptors: *Floods, *Flood forecasting, *Flood flow, Flood frequency, Flood recurrence interval, Flood plains, Radioactive wastes, *Nevada, Nevada test site, *Radioactive waste disposal.

Guidelines for the evaluation of potential surface facilities for the storage of high-level radioactive wastes on the Nevada Test Site in southern Nevada include the consideration of the potential for flooding. Those floods that are considered to constitute the principal flood hazards for these facilities are the 100- and 500-year floods, and the maximum potential flood. Flood-prone areas for the three floods with present natural-channel conditions were defined for the eastern part of Jackass Flats in the southwestern part of the Nevada Test Site. The 100-year flood-prone areas would closely parallel most stream channels with very few occurrences of overland flooding between adjacent channels. The 500-year flood and the maximum potential flood would exceed the discharge capacities of main channels and cause overland flooding between adjacent channels throughout most of the study area. Excluded areas would be those located immediately east of the upstream reach of Topopah Wash and between upstream channel reaches of some tributaries. Floodflow characteristics for the three floods were determined at 47 cross sections. The magnitudes of the estimated velocities indicate severe erosion of channels and flood plains would occur in parts of the study area. (USGS)
W81-05017

FLOOD-PLAIN AREAS OF THE MISSISSIPPI RIVER, MILE 866.8 TO MILE 888.0, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
G. H. Carlson, and L. C. Guetzkow.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $19.75 in paper copy, $5.50 in microfiche. Geological Survey Open-File Report 80-972 (WRI), 1980. 11 Sheets, 7 Fig, 8 Plates, 2 Tab, 3 Ref.

Descriptors: *Flood plains, *Streamflow, *Flood-peak, *Flood recurrence interval, Flood profiles, Mapping, Flood plain management, Flood protection, Regional floods, Computer models, Flood discharge, Flood data, *Minnesota, *Mississippi River.

Profiles of the regional flood, 500-year flood, and flood-protection elevation have been developed for a 21-mile reach of the Mississippi River. Areas flooded by the regional flood and by the 500-year flood were delineated by photogrammetric mapping techniques and are shown on seven large-scale map sheets. Over 1,300 acres of flood plain are included in the cities of Anoka, Champlin, Coon Rapids, Dayton, Ramsey and Elk River, and in unincorporated areas of Wright County. The flood-outline maps and flood profiles comprise data needed by local units of government to adopt, enforce, and administer flood-plain management regulations along the Mississippi River throughout the study reach. Streamflow data from two gaging stations provided the basis for definition of the regional and 500-year floods. Cross-section data obtained at 83 locations were used to develop a digital computer model of the river. Flood elevation and discharge data from the 1965 flood provided a basis for adjusting the computer model. Information relating the history of floods, formation of ice jams, and duration of flood elevations at Anoka and at Elk River are included. (USGS)
W81-05018

DEVELOPMENT DOCUMENT FOR THE PORCELAIN ENAMELING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W81-05034

URBAN STORMWATER MANAGEMENT IN SOUTHEAST,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 6E.
W81-05100

A MODEL TO FORECAST SHORT-TERM SNOWMELT RUNOFF USING SYNOPTIC OBSERVATIONS OF STREAMFLOW, TEMPERATURE, AND PRECIPITATION.
Geological Survey, Tacoma, WA.
For primary bibliographic entry see Field 2A.
W81-05138

ADAPTIVE FILTERING THROUGH DETECTION OF ISOLATED TRANSIENT ERRORS IN RAINFALL-RUNOFF MODELS.
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 2A.
W81-05140

COMPARISON OF ANNUAL AND PARTIAL DURATION SERIES FLOODS ON THE MURRUMBIDGEE RIVER,
Riverina Coll. of Advanced Education, Wagga Wagga (Australia). Dept. of Geography.
K. J. Page, and L. McElroy.
Water Resources Bulletin, Vol 17, No 2, p 286-289, April, 1981. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Flood recurrence interval, *Mathematical studies, Langbein's function, Comparison studies, Murrumbidgee River, Floods, *Flood frequency, Flood forecasting, Forecasting, Flood data, Flood control, *Australia.

The aim of this paper is to compare flood frequencies computed from two data series measured on the Murrumbidgee River, New South Wales, Australia. The annual series approach was based upon the sequence of flood peaks which occurs in a succession of yearly periods. The partial duration series is based on the sequence of flood peaks which exceed some base level of flow. The recurrence intervals generated by these two approaches are not equivalent, however, and conversion of recurrence intervals from one series to the other is usually achieved by a mathematical function developed by Langbein in 1949. However, through the study of data collected by these two approaches on the Murrumbidgee River, it was suggested that the Langbein conversion function does not always provide a reliable means of comparing recurrence intervals. The Langbein function understated the discrepancy between the two sets of recurrence intervals by approximately 35% for discharges more frequent than the three year annual flood. Langbein's own North American data appears to be consistent with data collected on the Murrumbidgee River. An empirical relationship is developed in the paper which may offer a more prudent approach for flood forecasting. (Baker-FRC)
W81-05164

EFFECT OF SURFACE MINING ON STORM FLOW AND PEAK FLOW FROM SIX SMALL BASINS IN EASTERN KENTUCKY,

Georgia Univ., Athens. School of Forest Resources.
For primary bibliographic entry see Field 4C.
W81-05167

PLOTTING FORMULA FOR FLOOD FREQUENCY,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski.
Water Resources Bulletin, Vol 17, No 2, p 197-202, *April, 1981. 3 Fig, 2 Tab, 13 Ref.*

Descriptors: *Flood frequency, *Flood forecasting, *Forecasting, Mathematical studies, Frequency analysis, Mathematical models.

In flood frequency analysis it is necessary to estimate the values of probabilities based on plotting formula. All of the many existing formulae provide different results, particularly at the tails of the distribution. *The existing practice in selection of a* particular formula is rather arbitrary, and often Weibull's formula is recommended, which provides biased and conservative results. *A new plotting* formula is developed based on the mean square criterion. The plotting is very useful for evaluation of distribution assumptions and detection of outliers. When the flood frequency analysis is performed using a Gumbel Type-I distribution, then the plotting formula developed in this paper, a *good approximation to the true exceedance prob*ability at high values is obtained. For Pearson Type-III distribution, no single plotting formula is strictly correct. However, if one compromise formula is required which can be used with all distributions, then the formula developed in this paper may be suitable. (Baker-FRC)
W81-05169

***A SIMPLE PROCEDURE FOR DEVELOPING* A DESIGN STORM HYDROGRAPH.**
Kentucky Univ., Lexington. Dept. of Agricultural *Engineering.*
For primary bibliographic entry see Field 2A.
W81-05172

GENERALIZED SKEW COEFFICIENTS FOR FLOOD FREQUENCY ANALYSIS.
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Bulletin, Vol 17, No 2, p 262-269, April, 1981. 6 Fig, 7 Tab, 14 Ref.

*Descriptors: *Flood frequency, *Frequency analysis,* Model studies, Floods, Forecasting, *Flood forecasting, Flooding, Mathematical studies, Water *resources development.*

Various methods of determining generalized skew coefficients based on a weighting procedure were determined. The generalized skew is derived as a weighted average between coefficients. Existing methods which determine the weight simply as a function of data size are discussed. A weighting procedure is derived which is a function of the variance of sample skew and the variance of the map skew. Such a procedure considers the uncertainty of deriving a skew coefficient from both sample data and regional or map values to derive a generalized skew that minimizes uncertainty based on known information. The variance of the sample skew can be determined using either of two nonparametric methods called the jackknife and the bootstrap. These two methods and the application to computing the variance of sample skews are discussed. An experimental study is performed to compare the various methods of deriving generalized skew coefficients. (Baker-FRC)
W81-05176

FREQUENCY OF DRY DAY SEQUENCES.
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2B.
W81-05178

RUNOFF--A MAJOR ELEMENT OF THE HYDROLOGICAL CYCLE,
Rogers and Associates, Inc., Fort Smith, AR.
A. L. Prieur, Jr.
Southwest and Texas Water Works Journal, Vol *63, No 1, p 20-23, 32, April, 1981.*

Descriptors: *Runoff forecasting, *Runoff volume, *Rainfall-runoff relationships, Runoff coefficient, Surface runoff, Rainfall infiltration, Runoff.

Methods of determining surface retention, infiltration, and runoff during rainfall are discussed. Efficient design and operation of hydraulic projects depends on the reliable determination of rainfall-runoff relations and the forecasting of river and stream flows. At the beginning of a rain, interception or surface retention is high and a large portion *of the soil-moisture deficiency is satisfied before* surface runoff takes place. Storm runoff has usually been estimated using runoff coefficients, a subjective method whereby a coefficient is selected after observing the rain intensity and the location. Using the infiltration approach, surface runoff is equal to that portion of rainfall not disposed of through interception, evaporation during the storm, or infiltration. This method is satisfactory when the area being considered is homogeneous and small, such as an airport. Seasonal and annual runoff are often estimated. In these estimations, reservoir storage capacities and irrigation use can be factors. (Small-FRC)
W81-05190

EVOLUTION OF PHYSIOGRAPHY AND DRAINAGE IN SOUTHERN YUKON,
Geological Survey of Canada, Vancouver (British Columbia). Div. of Regional and Economic Geology.
D. Tempelman-Kluit.
Canadian Journal of Earth Sciences, Vol 17, No 9, p 1189-1203, September, 1980. 8 Fig, 28 Ref.

Descriptors: *Geologic history, *Surface drainage, Drainage patterns, *Drainage systems, Mountains, Glaciers, *Yukon.

A southeastern drainage system that probably existed in southern Yukon late in Tertiary time is described, and the evolution of the present northwest drainage is hypothesized. The physiography is dominated by upland plateaux and plateau remnants culminating in a mature erosion surface about Miocene time. Uneven uplift and faulting in the Late Miocene or Pliocene were thought to cause *the variations in the elevation of the surface. The* Tintina and Shakwak Trenches are young grabens superposed on the upland, and mountain ranges are youthful dissections of raised parts of the plateau. During the Miocene, water from central Yukon probably drained to the coast across the region occupied by the St. Elias and Coast Mountains. Probably during the late Miocene, general uplift occurred and the St. Elias and Coast Mountains rose unevenly above the interior Yukon. Thus, drainage became entrenched. Ice in the St. Elias outlasted ice in the interior during deglaciation, forcing dearrangements of the entrenched system. The less direct, northwest drainage of today resulted. (Small-FRC)
W81-05212

ORGANIC CARBON: OXIDATION AND TRANSPORT IN THE AMAZON RIVER,
Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 2K.
W81-05221

REQUIRED HEAD LOSS OVER LONG-THROATED FLUMES,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 8B.
W81-05317

2F. Groundwater

PRELIMINARY MAP SHOWING FRESHWATER HEADS FOR THE MISSION CANYON AND LODGEPOLE LIMESTONES AND EQUIVALENT ROCKS OF MISSISSIPPIAN AGE IN THE NORTHERN GREAT PLAINS OF MONTANA,
Geological Survey, Billings, MT.
W. R. Miller, and S. A. Strausz.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Map 80-729 (WRI), 1980. 1 Sheet, 14 Ref.

Descriptors: *Groundwater, *Maps, *Potentiometric level, Aquifers, Geohydrology, Groundwater potential, Wells, Water level fluctuations, *Great Plains, Mission Canyon limestone, Lodgepole limestone, Montana, North Dakota, South Dakota, Wyoming, Drill-stem tests.

A potentiometric-surface map showing freshwater heads for the Mission Canyon and Lodgepole Limestones of Mississippian age has been prepared as part of a study to determine the water-resources *potential of the Mississippian Madison Limestone* and associated rocks in the Northern Great Plains of Montana, North and South Dakota, and Wyoming. Most of the data used to prepare the map are from drill-stem tests of exploration and development wells drilled by the petroleum industry from 1946 to 1978. Some data are also from cased oil *wells, water-production wells, and springs. A short* explanation describes the seven categories of reliability used to evaluate the drill-stem-test data and *identifies several factors that might explain the* apparent anomalous highs and lows on the potentiometric surface. The map is at a scale of 1:1,000,000 and the potentiometric contour intervals are 100, 200, and 500 feet. (USGS)
W81-05008

PRELIMINARY MAP SHOWING FRESHWATER HEADS FOR THE RED RIVER FOR*MATION, BIGHORN DOLOMITE,* AND EQUIVALENT ROCKS OF ORDOVICIAN AGE IN THE NORTHERN GREAT PLAINS OF MONTANA, NORTH AND SOUTH DAKOTA, AND WYOMING,
Geological Survey, Billings, MT.
W. R. Miller, and S. A. Strausz.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Map 80-730 (WRI), 1980. 1 Sheet, 14 Ref.

*Descriptors: *Groundwater, *Maps, *Potentiometric level, Aquifers, Geohydrology, Groundwater* potential, Wells, Water level fluctuations, *Great Plains, *Red River Formation, *Bighorn Dolomite, Montana, North Dakota, South Dakota, Wyoming, Drill-stem tests.

A map showing freshwater heads for the Ordovician Red River Formation, Bighorn Dolomite, and equivalent rocks has been prepared as part of a study to determine the water-resources potential of the Mississippian Madison Limestone and associated rocks in the Northern Great Plains of Montana, North and South Dakota, and Wyoming. Most of the data used to prepare the map are from drill-stem tests of exploration and development wells drilled by the petroleum industry from 1964 to 1978. A short explanation describes the seven categories of reliability used to evaluate the drill-stem-test data and identifies several factors that might explain the apparent anomalous highs and lows on the potentiometric surface. The map is at a scale of 1:1,000,000 and the potentiometric contour interval is 100 feet. (USGS)
W81-05009

GEOHYDROLOGY OF THE ANTLERS AQUIFER (CRETACEOUS), SOUTHEASTERN OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.
D. L. Hart, Jr., and R. E. Davis.
Oklahoma Geological Survey, Norman Circular 81, 1981. 33 p, 10 Fig, 1 Plate, 6 Tab, 22 Ref, Append.

Descriptors: *Groundwater, *Geohydrology, *Available water, Aquifer characteristics, Infiltration, Precipitation, Water yield, Water use, Well data, Hydrologic properties, Groundwater movement, Recharge, Discharge measurement, Water quality, Chemical analysis, *Oklahoma, Southeastern Oklahoma, Antlers aquifer.

The Antlers aquifer, which consists of as much as 900 feet of friable sandstone, silt, clay, and shale crops out in areas of 1,860 square miles and underlies about 4,400 square miles in southeastern Oklahoma. Precipitation ranges from 34 to 50 inches per year across the outcrop area which is well suited to allow high rates of infiltration. The aquifer contains an estimated 70,000,000 acre-feet of water having less than 1,000 milligrams per liter dissolved solids. The average saturated thickness is 250 feet. Aquifer tests indicate the average transmissivity is 1,480 feet squared per day and the average storage coefficient is 0.0005. Large capacity wells tapping the aquifer commonly yield 100 to 500 gallons per minute; the maximum measured yield is 1,700 gallons per minute. Water usage from the aquifer is very small owing to an abundance of surface water. Water quality throughout the central and northern part of the aquifer is generally acceptable for municipal use. However, a few wells yield water containing concentrations of iron and manganese exceeding the limit recommended by the National Academy of Science for municipal use. (USGS)
W81-05010

WATER RESOURCES OF THE TERRACE AQUIFERS, CENTRAL LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
J. L. Snider, and T. H. Sanford, Jr.
Louisiana Department of Transportation and Development, Office of Public Works, Baton Rouge *Water Resources Technical Report No 25, 1981.* 48 p, 1 Fig, 12 Plates, 4 Tab, 15 Ref.

Descriptors: *Groundwater availability, *Geohydrologic units, *Aquifer characteristics, Water supply, Water use, Water quality, Water pollution, Chemical analysis, Saline water intrusion, Transmissivity, Hydraulic conductivity, Baseflow, Evapotransporation, Surface-groundwater relations, Rainfall, Groundwater recharge, Infiltration, Wells, Groundwater movement, Water level fluctuations, Water yield, Chlorides, Hydrologic data, Central Louisiana, Terrace aquifers, *Louisiana.

In parts of central Louisiana the terrace aquifers of Pleistocene age are a potential source of water for public-supply and industrial uses. The units are generally under water-table conditions and are relatively thin; the saturated thickness averages about 25 feet. Hydraulic conductivity of the terrace aquifers averages 220 feet per day. Specific capacities of wells are as much as 50 gallons per minute per foot of drawdown. The source of water to the terrace aquifers is mostly infiltration from rainfall. The average annual rate of infiltration is about 0.5 foot per year in most of the project area. This rate of infiltration would sustain a continuous yield of about 200 gallons per minute per square mile. Water from the terrace aquifers in most of the project area is soft and is low in dissolved solids. Water having anomalously high concentrations of chloride occurs in parts of the project area. In some areas the high chloride may be from oil-field sources, and in some areas from inflow from underlying saltwater-bearing units. (USGS)
W81-05011

HYDROGEOLOGY OF THE BUFFALO AQUIFER, CLAY AND WILKIN COUNTIES, WEST-CENTRAL MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-05013

DISSOLVED-SOLIDS AND RATIO MAPS OF WATER IN THE MADISON GROUP, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
R. D. Feltis.
Montana Bureau of Mines and Geology, Butte, Hydrogeologic Map 3, 1980. 3 Sheets.

Descriptors: *Groundwater, *Maps, *Dissolved solids, *Water quality, *Aquifer characteristics, Geohydrology, Surface-groundwater relations, Groundwater movement, Groundwater recharge, Wells, Water sampling, Salinity, Chemical analysis, *Montana.

Three maps that show the general quality of water in the Madison Group of Mississippian age. The maps are part of a preliminary study of the geohydrology of the Madison Group in eastern Montana. Other maps in the series show that potentiometric surface of the Madison aquifer at a scale of 1:1,000,000 and the configuration of the top of the Madison Group at a scale of 1:250,000. Data sites are oil tests or production wells, water wells, and springs. Water samples from oil tests or production wells are from drill-stem tests, flows sampled during the drilling process, or production water. Many water samples were contaminated with drilling fluid; however, the analyses used for the map were selected after review of the drill-stem-test recovery data or other sample-collection data and are considered to be representative of formation water. The chemical analyses range in age from 1920 to 1977. (USGS)
W81-05015

ASSESSMENT OF THE SANTA MARGARITA SANDSTONE AS A SOURCE OF DRINKING WATER FOR THE SCOTTS VALLEY AREA, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W81-05016

DATA-BASE SYSTEM FOR NORTHERN MIDWEST REGIONAL AQUIFER-SYSTEM ANALYSIS,
Geological Survey, Madison, WI. Water Resources Div.
A. L. Kontis, and R. J. Mandle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-205650, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-104, December, 1980. 23 p, 12 Fig.

Descriptors: *Simulation analysis, *Groundwater, *Flow, Regional analysis, Aquifer systems, Data collection, Data storage and retrieval, Geohydrology, Computer models, Mapping, Automation, *Northern Midwest, Regional Aquifer-System Analysis(RASA).

A computerized data-base system was developed to facilitate collection and use of large quantities of data for a model study of the Cambrian-Ordovician aquifer system in the Northern Midwest. Input to the data-base system consists of either point values or digitized contour maps of hydrogeologic data required by the model. Uniformly spaced model-node values are then computed from the discrete data by two-dimensional interpolation. Nonuniformly-spaced nodal values may be obtained by fitting two-dimensional polynomials (bicubic splines) to surfaces formed by uniformly spaced points and solving for the surface values at the node locations. The data-base system has the following attributes: (1) manual handling of data is minimized and machine handling of data is maximized, (2) given unequally spaced point data over the extent of the study area, model input arrays for any reasonable uniform node spacing can be rapidly computed, (3) accuracy of computed node values are generally compatible with accuracy and spatial distribution of point data, (4) a relatively large class of nonuniformly spaced node configurations can be computed, (5) data within files can be easily accessed and edited, and (6) the occurrence of data processing errors at various stages of data-base generation is monitored by machine contouring the computed grids. (USGS)
W81-05019

GROUND-WATER HYDROLOGY OF THE LITTLE KANAWHA RIVER BASIN, WEST VIRGINIA.
West Virginia Geological and Economic Survey, Morgantown. Water Research Div.
West Virginia Geological and Economic Survey, Morgantown Map WV-10, 1980. 1 Sheet, 2 Ref. (Compiled by Hobba, W.A., Jr.).

Descriptors: *Groundwater, *Water quality, *Specific gravity, Watersheds, Geohydrologic units, Aquifers, Water-level fluctuations, Water yield, Specific conductivity, Wells, Saline water, Chemical analysis, Maps, *West Virginia, Little Kanawha River basin.

This atlas report summarizes the ground-water resources of the Little Kanawha River basin in West Virginia from an earlier report describing the total water resources of the same basin. This sparsely populated basin of 2,310 square miles lies in western West Virginia. Approximately 87 percent of the basin is forested, 12 percent is agricultural land, and 1 percent is under urban or residential development. Five to seven inches of precipitation recharges the ground-water reservoir annually. Water levels are highest in the spring and lowest in the fall. There are a few localities where groundwater supply at shallow depths is inadequate for household use. However, yields of wells range from less than 2 to more than 300 gallons per minute, but average yields of wells in the various geologic units range from 5 to 23 gallons per minute. Valley wells generally yield more water than wells in other topographic locations. Groundwater quality, as determined from 795 partial analyses and 48 complete chemical analyses, is poor in about half of the basin. Concentrations of hardness and iron are high in ground water in the southern half of the basin, and concentrations of chloride are high in many valley areas. Chloride concentrations exceed 1000 milligrams per liter in some wells that are less than 50 feet deep. (USGS)
W81-05020

GROUND-WATER LEVELS IN SELECTED WELL FIELDS AND IN WEST-CENTRAL FLORIDA, MAY 1980,
Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, L. R. Mills, and W. M. Woodham.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.00 in paper copy, $1.00 in microfiche. Geological Survey Open-File Report 80-1001, 1980. 2 Sheets, 2 Tab, 8 Ref.

Descriptors: *Potentiometric level, *Groundwater, *Maps, Subsurface water, Aquifers, Water table, Wells, Water level fluctuations, West-central Florida, Floridan aquifer, *Florida.

The water table in the surficial aquifer and the potentiometric surface of the Floridan aquifer in a 1,200-square-mile area in west-central Florida are mapped semiannually by the U.S. Geological Survey. Maps are prepared showing water levels measured in wells each May to coincide with seasonal low levels and each September to coincide with seasonal high levels. The mapped area shows 14 well-field areas that supplied 155 million gallons to municipalities on May 12, 1980. The water is withdrawn from the Floridan aquifer, the major aquifer in Florida. The effect of localized withdrawal of ground water is shown on the maps as depressions in both the potentiometric and water-table surfaces. Water levels were lower in May 1980 than in September 1979 and a little higher than the average May levels. Change of water levels ranged from a decrease of 12 feet at Verna well field to an increase of 7 feet at Eldridge-Wilde well field. (USGS)
W81-05022

DISCHARGE OF SALTWATER FROM PERMIAN ROCKS TO MAJOR STREAM-AQUIFER SYSTEMS IN CENTRAL KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5G.
W81-05023

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1980,
Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, W. M. Woodham, and G. R. Schiner.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.75 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-587, 1980. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, Aquifers, Water table, Wells, Water level fluctuations, Pumping, Irrigation, Southwest Florida, Southwest Florida Water Management, *Florida.

A May 1980 potentiometric-surface map of the Southwest Florida Water Management District depicts the annual low water-level period. Potentiometric levels decreased 5 to 36 feet between September 1979 and May 1980, in the citrus and farming sections of southern Hillsborough, southwestern Polk, northwestern DeSoto, Hardee, and Manatee Counties. Water levels in these areas are widely affected by pumping for irrigation and have the greatest range in fluctuations. Water-level decreases ranged from 0 to 8 feet in coastal, northern, and southern areas of the Water Management District. Generally, potentiometric levels were lower than previous May levels except in the northernmost and southernmost counties where water levels were 1 to 5 feet higher. (USGS)
W81-05024

ONE-DIMENSIONAL STEADY STATE SEAWATER INTRUSION IN LEAKY AQUIFERS,
Cairo Univ., Giza (Egypt). Dept. of Systems and Biomedical Engineering.
M. A. Hashish, M. E. Rasmy, and A. M. Amer.
Advances in Water Resources, Vol 4, No 1, p 34-42, March, 1981. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Saline water intrusion, *Leaky aquifers, *Differential equations, Encroachment, Seawater, Algorithms, Mathematical studies, Nile delta, Aquifers, Saline-freshwater interfaces.

An iterative technique is presented for computation of the location and shape of the interior interface for the one-dimensional steady state seawater intrusion problem in a leaky ocean aquifer. The algorithm is based upon backward integration of the differential equations representing the flow, starting from the point where the interface intersects the top of the aquifer. The algorithm is specific for conditions in the Nile Delta, where the aquifer is confined with a top semi-pervious layer and the interface is interior. The dependency of the locations of the top point as well as the bottom of the interface on the inland boundary condition are obtained through variational analysis of the governing equations. When information is available on whether the water hinge point lies on or outside the interface, computational effort can be reduced. Numerical examples are presented to demonstrate the efficiency of the technique. (Small-FRC)
W81-05094

ACID GROUNDWATER,
Swedish Water and Air Pollution Research Lab., Goeteborg.
For primary bibliographic entry see Field 5B.
W81-05106

NONLINEAR EFFECTS IN TWO-PHASE FLOW TO WELLS IN GEOTHERMAL RESERVOIRS.
Geological Survey, Menlo Park, CA.
M. L. Sorey, M. A. Grant, and E. Bradford.
Water Resources Research, Vol 16, No 4, p 767-777, August, 1980. 8 Fig, 3 Tab, 30 Ref.

Descriptors: *Geothermal studies, *Fluid flow, *Pressure head, Well hydraulics, Mathematical studies, Numerical analysis, Enthalpy, Steam, Drawdown, Groundwater movement.

The nonlinear responses of two-phase (steam and water) flow in geothermal wells were analyzed by numerical and quasi-analytical solutions. Simulated variations in pressure, saturation, and enthalpy of the flowing fluid mixture were compared for various initial reservoir conditions and relative permeability functions. Although the semilog pressure response during drawdown and overrecovery in liquid saturation following shut-in approached a straight line in most cases, curvature was more pronounced at low reservoir pressures than at high reservoir pressures. The flow enthalpy increased during drawdown as the phase ratio of steam to water in the fluid mixture increased. However, a stable value was reached near the well face after times sufficient for the semilog pressure response to straighten out. Estimates of reservoir porosity and definition of the relationship between water and steam relative permeabilities can be obtained from measurements of stable enthalpy and pressure transients at different discharge rates. (Cassar-FRC)
W81-05133

BOUNDARY INTEGRAL SOLUTIONS TO THREE-DIMENSIONAL UNCONFINED DARDY'S FLOW.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. P. Lennon, P. L. F. Liu, and J. A. Liggett.
Water Resources Research, Vol 16, No 4, p 651-658, August, 1980. 12 Fib, 3 Tab, 17 Ref.

Descriptors: *Porous media, *Darcys law, *Surface flow, Water boundary, Mathematical studies, Seepage, Aquifers, *Groundwater movement.

The boundary integral equation method is formulated for three-dimensional potential flow problems in porous media. The problems considered are time dependent and have a nonlinear boundary condition on the free surface. The entire boundary is discretized into linear finite elements in order to evaluate the boundary integrals. This technique allows transient, three-dimensional problems to be solved at reasonable computer costs. Examples illustrating the equations are (1) a groundwater recharge problem in an aquifer of infinite depth and horizontal extent, (2) recharge to an aquifer of finite depth, and (3) steady state flow from a pond through a homogeneous porous material down to a water table. (Cassar-FRC)
W81-05136

COMPUTER MODELS IN GROUND-WATER EXPLORATION,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
I. Remson, S. M. Gorelick, and J. F. Fliegner.
Ground Water, Vol 18, No 5, p 447-451, September-October, 1980. 4 Fig, 7 Ref.

Descriptors: *Computer models, *Aquifer characteristics, *Groundwater movement, Groundwater recharge, Recharge, Data interpretation, Cost allocation, Exploration, Decision making, Transmissivity, Leakage.

Computer models are useful in groundwater exploration to evaluate aquifer parameters and characteristics, in estimating groundwater recharge, in resolving data inconsistencies, and in determining optimal allocation of exploration funds. Four case histories illustrate these uses. Aquifer parameters and characteristics were estimated in the Palo Alto Baylands, California, a network of surface channels. Anomalous results indicated a need for further sampling, which revealed groundwater piping along root channels and a wedge-shaped permeable layer, thinning away from the channel. Groundwater recharge was estimated in the San Jacinto Valley, California. A model study showed leakage in the Pressure Subbasin, contrary to previous suppositions. Transmissivity measured at Tooele, Utah, gave radically different results when measured by pumping tests and specific capacity determinations. The model study determined which method gave the most reliable results. A drydock dewatering project in Taiwan was the subject of a model application, which showed that exploration funds should be spent on pumping tests along the constant head boundaries parallel to the long sides of the excavation rather than on hydraulic conductivity values within the excavation. (Cassar-FRC)
W81-05231

SAFE YIELD IN A COASTAL GROUNDWATER REGIME,
Hanover Univ. (Germany, F.R.). Inst. of Water Resources, Hydrology and Agricultural Engineering.
R. Mull, and G. Battermann.
Groundwater, Vol 18, No 5, p 459-463. September-October, 1980. 8 Fig, 6 Ref.

Descriptors: *Safe yield, *Recharge, *Saline water intrusion, Coastal aquifers, Coastal marshes, Marshes, Drainage, Groundwater recharge, Hydrologic models, Pumping, Model studies, Wells, Aquifers, Germany, North Sea area, Saline water intrusion.

Modeling determined the safe yield of a marshy area bordering the North Sea in northwest Germany. Saline water was located along the coast line and at about 250 meters depth. Increased pumping of fresh water would cause salt water intrusion into the wells. In the hilly central part of the 2500 sq km region, water infiltrates into the ground, flows in the saturated zone for several km, and discharges in the marsh (long cycle). In the marsh, precipitated water travels only a few meters before entering the drainage ditches (short cycle). If the groundwater level is lowered by increased pumping below the drainage system, the short cycle will be converted from drainage into a recharge. The greater the drawdown, the greater the recharge rate. Therefore, the depression of the water table is compensated to a certain degree. The quantity, 5 cu meters per sec, appears to be the maximum extractable groundwater amount if the wells are spread over the area. (Cassar-FRC)
W81-05234

GROUNDWATER MODELING: APPLICATIONS,
GeoTrans, Inc., Reston, VA.
J. W. Mercer, and C. R. Faust.
Groundwater, Vol 18, No 5, p 486-497, September-October, 1980. 22 Fig, 1 Tab, 11 Ref.

Descriptors: *Model studies, *Groundwater movement, *Solute transport, Numerical analysis, Aquifers, Mathematical models, Path of pollutants, Hydrology, Computer programs, Finite difference methods, Glacial soils, Musquodoboit, Nova Scotia, Rocky Mountain Arsenal, Chemical wastes, Landfills, Comparison studies.

The fourth in a series of articles on successful groundwater modeling discusses applications. Previous papers concerned an overview of numerical modeling, partial-differential equations used in modeling, and commonly-used numerical methods. Effective model application requires proper choice of a model and an appropriate computer program, sensitivity analysis, system conceptualization, data collection design, history matching, calibration and prediction. Although program input data and output results are quantitative, application of numerical models is partly subjective. A model cannot be exact, and complete data are never available. Consequently, success depends good scientific and intuitive judgment. This is more important in transport problems than with groundwater flow. Two model applications are discussed to illustrate the process. The first compares two alternative numerical methods to analyze an aquifer system composed of glaciofluvial deposits at Musquodoboit, Nova Scotia. The second example, a solute-transport model, uses a finite-difference solution to the groundwater flow equation combined with the method-of-characteristics solution to the solute-transport equation. The situation involves a leading chemical and pesticide waste dump at the Rocky Mountain Arsenal. (Cassar-FRC)
W81-05235

GEOTECHNICAL INVESTIGATIONS DURING DRILLING OF A DEEP DISPOSAL WELL IN DADE COUNTY, FLORIDA,
CH2M/Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5E.
W81-05236

STUDYING THE GROUND WATER FLOW CONDITIONS,
For primary bibliographic entry see Field 7B.
W81-05247

ELECTRONICS MONITOR ALBUQUERQUE WELLS.
For primary bibliographic entry see Field 7B.
W81-05250

AQUIFER PARAMETER ESTIMATION USING KALMAN FILTERS,
Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
S. Chander, P. N. Kapoor, and S. K. Goyal.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR1, p 25-33, March, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Aquifer characteristics, *Transmissivity, *Storage coefficient, Model studies, Leaky aquifers, Mathematical models.

The iterated extended Kalman filter (IEKF) was used to estimate parameters (transmissivity, storage coefficient, and leakage factor) and confidence limits for leaky and nonleaky aquifers in the presence of modeling and observational errors. The technique is sequential, and each added observation reduces the error covariance of the parameter estimates. Since the error covariance plots for coefficient of storage and transmissibility decrease rapidly for the first few observations, only a few observations are necessary. Comparison of the IEKF method with other methods for confined nonleaky and leaky aquifers shows that the IEKF method gives less residual sequential error and eliminates the subjectivity involved in the conventional curve matching techniques. (Cassar-FRC)
W81-05318

PRODUCTION OF UNDERGROUND WATER IN AFRICA (DE L'EXPLOITATION DES EAUX SOUTERRAINES EN AFRIQUE).
Aqua, No 4, p 2-4, April, 1980. 4 Fig.

Descriptors: *Well drilling, *Deep wells, *Water supply development, *Africa, Aquifers, Costs, Drilling equipment, Groundwater potential.

Costs of developing the Sahara's and Frezzan's water supply is prohibitive without international help. To cultivate 50,000 hectares of Sahara would cost $135 million. A 100 horsepower drill, costing $250,000, can drill one small well 80-130 meters deep each day. For village supplies (30-50 cu meters per hour) a 300 horsepower drill, costing $500,000, will drill one well per month in the deeper aquifers, 300-600 meters below the surface. In some areas water is not found above 1500 or more meters, requiring a 600 horsepower drill worth up to $2 million. These more extensive wells, 100-160 cu meters per hour, take six to eight weeks for drilling and another two weeks for completion. Water from these deep aquifers is hot, 50-70 degrees C, and has a high mineral content. A detailed example is given of a drilling project in Libya. (Cassar-FRC)
W81-05331

SAUDI ARABIA: HAIL WATER SUPPLY SCHEME.
For primary bibliographic entry see Field 5F.
W81-05341

AQUIFER RESPONSE IN THE ULTRAMAFIC FIELD AREA OF SUKHINDA VALLEY, ORISSA (INDIA),
National Geophysical Research Inst., Hyderabad (India).
I. Radhakrishna, and T. Venkateswarlu.
Groundwater, Vol 18, No 5, p 479-485, September-October, 1980. 7 Fig, 2 Tab, 11 Ref.

Descriptors: *Aquifer testing, *Drawdown, *Pumping tests, Wells, Hydrology, Observation wells, Artesian aquifers, Orissa, *India.

An exploratory test well and an observation well 30.5 meters from the main well were drilled near Kansa in the Sukhinda ultramafic body of the Cuttack District in Orissa, India. The test well was pumped for 48.5 hours and the drawdown data analyzed by six methods: Theis type-curve method, Jacob's straight-line method, Chow's method, Theis recovery method, Walton's leaky artesian type-curve method, and Hantush leaky artesian aquifer straight-line method. Comparing the results obtained by the different methods helped to determine the aquifer boundary conditions, long term withdrawal effects and well spacing. The inconsistency of hydrological parameters in the later periods of the time-drawdown curves, when analyzed with nonleaky artesian type formulae, was caused by vertical leakage in the system, not heterogeneity. A table lists the radius of influence for different discharge rates (0.20, 0.40, and 0.719 cu meters per min) and time (360, 720, 1440, and 2910 min). Maximum radius of influence was 255 meters at the highest discharge rate and longest pumping period. (Cassar-FRC)
W81-05347

2G. Water In Soils

EVALUATION OF AGRICULTURAL BMP ALTERNATIVES WITH THE FINITE ELEMENT STORM HYDROGRAPH MODEL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
M. D. Smolen, T. M. Younos, and V. O. Shanholtz
Paper No 81-2004 presented at 1981 summer meeting of American Society of Agricultural Engineers, Orlando, Florida, June 21-24, 1981, 22 p, 8 Fig, 3 Tab, 18 Ref. ASAE, St. Joseph, Michigan. OWRT-A-083-VA(3).

Descriptors: *Watershed management, *Land use, *Finite element method, Hydrologic models, Water quality, Distributed parameter model, Sediments, Overland flow, Spatial distribution, Soil water, *Drainage patterns, *Agricultural watersheds, Performance evaluation.

Many agricultural Best Management Practices (BMPs) involve alteration of drainage patterns or modification of soil infiltration in sections of a watershed. The effects of these modifications cannot be averaged reliably over the watershed area. Spatial interactions thus are not easily assessed by lumped parameter models. By using a distributed parameter model, the user is allowed to assign the parameter estimates to points of interest within the watershed. The Finite Element Storm Hydrograph Model (FESHM), developed at Virginia Tech, incorporates most of the advantages associated with the Aerial Nonpoint Source Watershed Environment Response Simulation model but has a more efficient discretization scheme using irregular polygons rather than a square grid. FESHM interfaces directly with separate data planes for soils, topography, and land use. This report discusses the application of FESHM to the design and evaluation of BMPs for cropland. It presents the results from verification studies, compares the results with several other currently accepted models, and presents a discussion of the potential advantages and apparent shortcomings of this modeling approach.
W81-05007

SURFACE HYDROLOGY: I--EXPLANATION OF PHENOMENA,
Technion-Israel Inst. of Tech., Haifa.
D. Zaslavsky, and G. Sinai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 1-16, January, 1981. 2 Fig, 14 Ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Rainfall infiltration, Hydrology, Surface runoff, Erosion, Infiltration, Base flow, Leaching, Puddling, Soil horizons, Horizontal flow, Irrigation, *Soil water, Flow characteristics.

A new approach in surface hydrology postulates that during rain and flow in a nonsaturated soil, a horizontal flow component, proportional to the vertical component and the slope, may exist. This idea may illuminate some as yet unexplained phenomena, in which water accumulates in concave areas and at soil cuts in otherwise unsaturated soil. Some of the phenomena related to this lateral flow mechanism are: (1) major portions of the rainfall are absorbed by the soil and later reemerge by seepage, (2) runoff follows a total amount of rain, not necessarily rainfall of momentarily high intensity, (3) runoff occurs even though infiltration capacity has not been exceeded, (4) formation of rills, gullies, and other erosion phenomena, (5) [illegible] permeable soils and soils locally waterlogged by lateral flow contribute to recharge of groundwater, (6) leaching phenomena, and (7) formation of a soil catena with B horizons. If statements of this type can be proved correct, the present view of surface hydrology (that runoff is produced either by rain that cannot penetrate the soil or by water that reaches the groundwater table) will be superseded. (Cassar-FRC)
W81-05088

SURFACE HYDROLOGY: II--DISTRIBUTION OF RAINDROPS,
Technion-Israel Inst. of Tech., Haifa.
D. Zaslavsky, and G. Sinai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 17-35, January, 1981. 7 Fig, 6 Ref.

Descriptors: *Rain, *Runoff, *Rainfall-runoff relationships, *Rainfall infiltration, Hydrology, Surface runoff, Erosion, Infiltration, Puddling, Horizontal flow, Splashing, Slopes, Recharge, Groundwater recharge, Soil water, Flow characteristics.

The second paper in a series on the horizontal flow component involved with rainfall-runoff relationships concerns raindrop splashes. Horizontal flow is proportional to the slope, the rainfall, and a given fraction of the kinetic energy of splashes. The horizontal flow due to rain splashes can reach several percent of the rate of rain over a given area. It is especially important in steep and short slopes. Concave areas in the landscape concentrate rainwater up to 50% of the average precipitation. The concentration is proportional to the curvature of the soil surface, except at high curvatures, where concentration of rain is probably moderate. High local effective rain can also result from the interaction between rain slanting and surface roughness. Thus runoff and waterlogging can occur in some places when the average rainfall does not exceed the soil's infiltration capacity. Likewise, groundwater recharge can occur even if the infiltration rate does not exceed evaporation. These conclusions point to the need for considering formerly neglected parameters in surface hydrology--variations in rain, infiltration, etc. (Cassar-FRC)
W81-05089

SURFACE HYDROLOGY: III--CAUSES OF LATERAL FLOW,
Technion-Israel Inst. of Tech., Haifa.
D. Zaslavsky, and G. Sinai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 37-52, January, 1981. 3 Fig, 16 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall infiltration, *Subsurface water, Hydrology, Surface runoff, Runoff, Erosion, Infiltration, Puddling, Horizontal flow, Irrigation, *Soil water, Slopes, Soil horizons, Hydraulic conductivity, Furrows, Pressure head, Soil surfaces, Flow characteristics.

The third in a series of papers on horizontal flow associated with rainfall-runoff relationships explores mechanisms producing lateral flow within

the soil. This downstream horizontal flow component occurs whenever pressure head and hydraulic conductivity decrease with elevation, as in the case of drainage and drying of the soil surface by evaporation. The presence of a surface transition layer heightens this effect. Thus, concave portions of the landscape sustain later flow and wet areas long after the rain has stopped. Then runoff will start sooner with the beginning of the next rainfall. Horizontal flow occurs at seepage faces, in exposed soil, and in litter-covered soil. Although all derivations were made for isotropic soil, the theory also applies to nonisotropic soil, where greater extremes in the phenomena are observed. These conclusions point out the advantages of leveling irrigated fields for even distribution of rain or irrigation water. Sharp-edged furrows lead to erosion and rapid runoff. (Cassar-FRC)
W81-05090

SURFACE HYDROLOGY: IV--FLOW IN SLOPING, LAYERED SOIL,
Technion-Israel Inst. of Tech., Haifa.
D. Zaslavsky, and G. Sinai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 53-64, January, 1981. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Soil horizons, *Anisotropy, *Subsurface water, Path of pollutants, Hydrology, Rainfall infiltration, Infiltration, Horizontal flow, Slopes, Pressure head, *Soil water, Geologic faults, Hydraulic conductivity, Flow characteristics, Soil water movement.

A sloping, layered soil behaves as an anisotropic medium in the case of a cyclic, two-layered soil and steady-state flow. Soil layers influence the subsurface flow. When layers are parallel to the soil surface, moisture concentrations due to splashes, the surface transition zone, and layering, are additive. If layers are truncated due to excavation or erosion, streamlines bend downward and moisture accumulates until seepage begins. This explains the presence of springs in geologic fault areas in the absence of a saturated water table. The mechanism can also be applied to tracing the path of a pollutant, which may spread significantly in a horizontal direction. (Cassar-FRC)
W81-05091

SURFACE HYDROLOGY: V--IN-SURFACE TRANSIENT FLOW,
Technion-Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 2A.
W81-05092

ANALYSIS OF SURFACE MOISTURE VARIATIONS WITHIN LARGE-FIELD SITES,
Maryland Univ., College Park. Dept. of Civil Engineering.
K. R. Bell, B. J. Blanchard, T. J. Schmugge, and M. W. Witczak.
Water Resources Research, Vol 16, No 4, p 796-810, August, 1980. 11 Fig, 4 Tab, 25 Ref.

Descriptors: *Soil moisture, *Variability, *Sampling, Statistical analysis, Moisture content, Standard deviation, Data acquisition.

Soil moisture data from 58 large field sites (40 acres each) were statistically analyzed to determine the relationship between soil moisture variability and mean field moisture. The fields, located in Arizona, Kansas, and south Dakota, were bare or had uniform vegetative cover and were relatively level. During 1974-1977 NASA collected soil moisture data using two methods: the integrated layer procedure (increments of 0-1, 1-2, 2-5, 5-9, and 9-15 cm) and the individual layer procedure (0-2.5, 0-5, and 0-10 cm from the surface in the South Dakota study). The study concluded that (1) moisture variations within any given large field area were normally distributed about the mean, (2) neither a single (constant) standard deviation nor a coefficient of variation uniquely defined variability over the complete range of mean field moisture contents, and (3) an upper bound standard deviation parameter more clearly defined the maximum range of anticipated variability, especially at higher moisture levels. In the integrated layer approach, 87% of the observed values of the standard deviation were less than or equal to 3%, and 96% were less than 4%. The individual layer approach resulted in standard deviations of 4% for 90% of the values and 5% for 98% of the values. The limit of error curves (the number of samples at a given location) were more a function of moisture content than of depth. It was recommended that 16-25 sampling points per 40-acre field be used for future testing. (Cassar-FRC)
W81-05093

VARIATION WITHIN TEXTURE CLASSES OF SOIL WATER PARAMETERS.
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
D. L. Brakensiek, R. L. Engleman, and W. J. Rawls.
Transactions of the ASAE, Vol 24 No 2, p 335-339, March-April 1981. 2 Fig, 6 Tab, 18 Ref.

Descriptors: *Infiltration, *Soil water, Soil moisture, Soil texture, Sand, Clays, Green-Ampt equation.

This study provides values for parameters to be used in the Green and Ampt infiltration equation. The Brooks and Corey effective saturation-capillary pressure equation was fitted to 1.085 soil moisture characteristics for 10 soil textures--sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, sandy clay loam, silty clay loam, sandy clay loam, silty clay, and clay. Within each texture class the pore size index, bubbling pressure and total porosity were transformed to a normal distribution. The Green and Ampt parameters, wetting from capillary head and K-Conductivity, were calculated from the Brooks and Corey equation parameters. Mean values and standard deviation were calculated for each soil texture class, and a transformation for normality and variance stability was determined. (Cassar-FRC)
W81-05128

THE POTENTIAL OF REMOTELY SENSED THERMAL INFRARED DATA TO INFER SURFACE SOIL MOISTURE AND EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 7B.
W81-05132

COMPARISON OF MEASURED AND ESTIMATED UNSATURATED HYDRAULIC CONDUCTIVITY.
Newcastle upon Tyne Univ. (England), Dept. of Agricultural Engineering.
M. E. Parkes, and P. A. Waters.
Water Resources Research, Vol 16, No 4, p 749-754, August, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Hydraulic conductivity, *Soil moisture retention, *Pore water, Conductivity, Lysimeters, *Unsaturated flow.

Unsaturated hydraulic conductivity data were obtained for 3 monolith lysimeters, 80 cm in diameter by 135 cm deep, using the instantaneous profile technique. A neutron probe was used to measure soil moisture. Conductivity estimates were also obtained by laboratory measurements of soil moisture characteristics using the modified Millington and Quirk computational method. At a matching point near saturation, ratios of calculated to measured conductivity were large, suggesting that only a minor proportion of the soil pore space was contributing to flow. Within freely drained soil profiles the hydraulic conductivity estimates using the instantaneous profile technique changed by several orders of magnitude for small changes in soil moisture content. Such estimates appear to relate to water movement though a fissure network which permeates the entire profile. Therefore field measurements of unsaturated hydraulic conductivity need to consider pore space associated with the residual moisture contents, which do not contribute to flow under conditions close to unit hydraulic gradients. (Cassar-FRC)
W81-05134

MODELING SOIL WATER CHANGES IN A WELL-STRUCTURED, FREELY DRAINING SOIL.
Newcastle upon Tyne Univ. (England). Dept. of Agricultral Engineering.
M. E. Parkes, and J. R. O'Callaghan.
Water Resources Research, Vol 16, No 4, p 755-761, August, 1980. 7 Fig, 24 Ref.

Descriptors: *Soil water, *Hydraulic conductivity, *Evapotranspiration, Lysimeters, Soil-water-plant relationships, Unsaturated flow, *Model studies, Mathematical models.

Changes of soil water content were measured in three monolith lysimeters, 80 cm in diameter and 125 cm deep. Results were compared with changes predicted by two programs: a soil water budgeting program and a program incorporating a finite element solution of the unsaturated soil water flow equation. Both models underestimated water uptake during periods of high evapotranspiration. The physically based model (finite element solution) gave good results of flow from a lysimeter in the absence of root water uptake. Further knowledge of the general behavior of crop canopy resistance is required; measurements of unsaturated hydraulic conductivity by other techniques would also improve this model. The empirical soil water budget program was a better approach to long term water balance calculations. (Cassar-FRC)
W81-05139

CHANGES IN SOLUTION OF FOREST SOILS WITH WATERLOGGING AND THREE LEVELS OF BASE SATURATION,
Southern Forest Experimental Station, New Orleans, LA.
For primary bibliographic entry see Field 2K.
W81-05142

DETERMINING LEACHING FRACTION FROM FIELD MEASUREMENTS OF SOIL ELECTRICAL CONDUCTIVITY,
Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W81-05252

LEACHING AND WATER-TYPE EFFECTS ON GROUNDWATER QUALITY,
Science and Education Administration, Riverside, CA. Salinity Lab.
D. L. Suarez, and M. T. van Genuchten.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR1, p 35-52, March, 1981. 9 Fig, 12 Ref.

Descriptors: *Salinity, *Leaching, *Irrigation efficiency, *Water quality, Irrigation water, Calcium carbonate, Water table, Gypsum, Model studies, Mathematical models, Soil water movement, Groundwater movement, Chemical properties, Chemical precipitation.

A one-dimensional numerical analysis of water and salt movement in a 50 meter deep unsaturated-saturated soil profile showed the effects of leaching on groundwater salinity. Irrigation water was classified into 3 types: (1) waters initially unsaturated with CaCO3, (2) waters initially saturated with CaCO3, and (3) waters nearing saturation with gypsum and saturated with CaCO3. For CaCO3 saturated water, the effects of improved irrigation efficiency (reduced leaching) are minor, especially with a shallow unsaturated zone. As the depth to the water table increases, the mean residence time of the salt increases, and less reaches the groundwater. For type 3 waters reduced leaching significantly improves groundwater salinity even in shallow aquifer systems. Leaching fractions of 0.1 and 0.4 produced salinity levels of about 15 and 30 milliequivalents per liter, respectively, over a 100 year simulation. If a basin is underlain by saline groundwater, with better quality water at a greater depth, low leaching is very desirable to protect the deeper water sources. In regions with poor groundwater quality, downstream river salinity

would be an important consideration in choosing an irrigation strategy. (Cassar-FRC)
W81-05260

INFILTRATION EQUATIONS MODIFIED FOR SURFACE EFFECTS.
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR1, p 71-86, March, 1981. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil surfaces, Mulching, Seepage, Runoff, Model studies, Mathematical models, Equations, Hydrology.

The Green-Ampt-Mein-Larson (GAML) model was the basis of a series of equations developed for predicting inflitration into soils with modified surfaces (mulching, incorporated organic matter, or sealing). In the case of a uniform soil profile, these equations reduce to the Green-Ampt and Mein-Larson 2-state infiltration equations. Predicted and observed infiltration rates for coarse (Lewiston fine sandy loam) over fine (Millville silt loam) and fine over coarse stratifications showed good agreement with each other and with the Richards numerical equation. Application to an Ida silt loam soil illustrated the magnitude of the predicted effect of surface sealing on infiltration, using 2 different initial moisture contents, 3 different rainfall intenstiy ratios, and 4 different conductivity ratios. (Cassar-FRC)
W81-05261

A SYSTEM FOR AUTOMATICALLY MEASURING AND RECORDING SOIL WATER POTENTIAL AND RAINFALL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
P. S. Blackwell, and M. J. Elsworth.
Agricultural Water Management, Vol 3, No 2, p 135-141, 1980. 4 Fig, 9 Ref.

Descriptors: *Soil water potential, *Measuring instruments, Soil water, Moisture tension, Tensiometers, Rainfall, Rain gages, Automation, Hydraulic properties.

Measurements of soil water potential are becoming a useful part of agricultural and geomorphological research. A method is described for the atuomatic simultaneous measurement and recording of rainfall and soil water potential by tensiometers with fluid scanning switches and pressure transducers. Rain is collected in a catching trough and fed into a series of collection bottles through which the fluid switch system measures water depth. An electronic device measures water depth and regulates the frequency and rate of scanning by the fluid switch, while a data logger collects signals from the tensiometer and rain gage. The data logger also receives calibration values to calculate the hydraulic potential and rain depths. Results of numerous tests for accuracy, reliability and response to sudden changes in water potential and rainfall showed that the present method was suitable for use in routine agricultural and geomorpholoical research. (Geiger-FRC)
W81-05305

SIMULATION OF WATER FLOW IN THE SOIL UNDER SUB-SURFACE TRICKLE IRRIGATION WITH WATER UPTAKE BY ROOTS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
G. Oron.
Agricultural Water Management, Vol 3, No 3, p 179-193, 1980/1981. 10 Fig, 23 Ref.

Descriptors: *Trickle irrigation, *Simulation analysis, *Flow discharge, Irrigation, Roots, Soil water, Root zone, Soil-water-plant relationships, Subsurface irrigation, Flow characteristics.

Any irrigation procedure must take into consideration the problems involved in water application under pressure from a sub-surface point source. The amount of water leakage under the root zone is affected by the choice between continuous and intermittent water application and decisions about emitter spacing and depth in the soil. This paper presents a combination of theoretical results and the findings of field studies which indicate a potential direction for improving the management of sub-surface trickle irrigation systems. Water uptake by roots is presented as a continuous sink function and incorporated into the flow equation in the unsaturated zone. The resultant steady-state nonlinear equation is linearized and then solved numerically. This model provides a means for determining the influence of water demand and the intensity of the water source on water uptake by roots, leakage under the root zone, and progress of the wetting front. The procedure leads to a relatively simple differential equation, which is essentially a corrected form of previous solutions which disregard the uptake effect and the pressure head at the outlet of the sub-surface emitter. Field experiments performed in a sugar beet field in Israel confirmed the results of the theoretical model indicating that continuous water application is associated with increased water leakage under the root zone. Short discharge pulses followed by relatively long breaks could improve water management in the field and increase irrigation efficiency. Further confirmation of the theoretical model is needed before the results can be applied for engineering purposes. (Carroll-FRC)
W81-05312

DISTRIBUTION OF WATER AND SALT IN SOIL UNDER TRICKLE AND POT IRRIGATION REGIMES,
Tehran Univ., Karaj (Iran), Dept. of Irrigation Engineering.
For primary bibliographic entry see Field 3F.
W81-05313

2H. Lakes

SAMPLING STRATEGIES FOR ESTIMATING THE MAGNITUDE AND IMPORTANCE OF INTERNAL PHOSPHORUS SUPPLIES IN LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-206237, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-015, April, 1981. 95 p, 24 Fig, 7 Tab, 156 Ref.

Descriptors: *Lakes, *Sampling, *Phosphorus, *Sediments, *Cycling nutrients, Catchment areas, Calcareous soils, Chemical precipitation, Water quality, Water temperature, Ions, Chlorophyll, Specific conductivity.

The physical and chemical factors controlling sediment release and water column recycling of phosphorus and other nutrients are discussed within a 'systems' framework, and sampling strategies for estimating the magnitude and importance of internal phosphorus supplies in lakes are considered. Lakes are considered as physical-chemical systems with compartments influencing one another through linkages. The three major compartments are the drainage basin, the water, and the sediments. Sediment bulk chemical composition depends on the physical nature of the sediment and the iron and phosphorus reactions in calcareous or non-calcareous sediments. In non-calcareous lakes phosphorus is precipitated out as ferric phosphate, because the Fe/P ratio is high, resulting in low phosphorus levels in the water. In calcareous lakes, where the Fe/P ratio is low, phosphorus remains in the water, and iron is selectively precipitated out as ferrous sulfide. Analytical methods are given for lake temperature, pH, DO, cations, anions, nutrients, chlorophyll, and conductance. Lake temperature estimation is affected by seiches and other wave disturbances, and lake morphometry. Models are available for estimating vertical nutrient fluxes. (Brambley-SRC)
W81-05050

LAKE DATA ANALYSIS AND NUTRIENT BUDGET MODELING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 7A.
W81-05055

CLEAN LAKES PROGRAM STRATEGY.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Report EPA-440/5-80-014, August, 1980. 24 p, 14 Fig.

Descriptors: *Lake restoration, *Water pollution control, *Water quality management, *Recreation, Trophic level, Water pollution sources, Federal jurisdiction, State jurisdiction, Urban lakes, Watershed management, Evaluation, Financing.

The Clean Lakes Program is now fully operational, with the goal of protecting at least one lake with water quality suitable for contact recreation, or to restore a degraded lake to that condition, within 25 miles of every major population center. To participate in the program the States are required to classify by trophic condition, their publicly owned freshwater lakes that are in need of restoration or protection; they then investigate the causes of decline and recommend programs to restore or preserve the quality of individual lakes, and implement the pollution control or restoration measures. All three phases are eligible for Federal financial support. Urban lakes will receive initial priority. Five specific objectives have been set: select projects to maximize public benefits; follow integrated program approach; emphasize watershed management; develop active State involvement and maintain Federal-State partnership; and conduct continuous program and project evaluation. A set of operational tasks which must be accomplished in order to attain the objectives has been identified. Some are EPA Headquarters responsibilities and some are Regional. It is predicted that to meet the goal will require $150 million in Federal funds. (Brambley-SRC)
W81-05059

MOBILIZATION OF SEDIMENT PHOSPHORUS BY SUBMERSED FRESHWATER MACROPHYTES,
Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Barko, and R. M. Smart.
Freshwater Biology, Vol 10, No 3, p 229-238, June 1980. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Phosphorus, *Macrophytes, Nutrients, *Sediments, Bottom sediments, Lakes, Eutrophication, Reservoirs, *Rooted aquatic plants, Phosphorus cycle.

Sediment P mobilization by Egeria densa Planch, Hydrilla verticillata Royle, and Myriophyllum spicatum L. was examined using five different sediments. The potential influence of submersed macrophytes on the P cycle and metabolism of lacustrine system was also examined. The investigation was conducted in a controlled environment chamber at temperatures maintained between 18 and 20C. Sediments were placed in sediment containers and allowed to settle for several weeks. Apical shoots were planted in the sediment samples. After two weeks all shoots had commenced active growth. The columns were filled with a P-free nutrient solution, a modified Bold's Basal Medium. The sediments used ranged from a predominantly sandy sediment to totally fine-textured sediments. In general there was a low root to shoot biomass ratio, indicating the minor contributions of roots to the total biomass of these submersed species. Plant tissue P concentrations were high. The amounts of P absorbed from sediments and translocated to shoots by the macrophytes differed among species and sediments. With few exceptions, cumulative P released from plant shoots during the study represented less than 10% of the total P mobilized. This mobilization of sediment P by submersed macrophytes represents an important aspect of the P cycle, and may affect the overall metabolism of lacustrine systems. (Baker-FRC)
W81-05117

FOSSIL DIATOMS AND SCALES OF CHRYSOPHYCEAE IN THE RECENT HISTORY OF HALL LAKE, WASHINGTON,
Hood Coll., Frederick, MD. Dept. of Biology.
For primary bibliographic entry see Field 2D.
W81-05118

SEASONAL SUCCESSION OF PHYTOPLANKTON IN ONONDAGA LAKE, NEW YORK (U.S.A.).
Georgetown Univ., Washington, DC. Dept. of Biology.
P. Sze.
Phycologia, Vol 19, No 1, p 54-59, March, 1980. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Seasonal variation, *Eutrophication, Lakes, *Onondaga Lake, New York, Succession, Phosphorus compounds, Silica, Nutrients, Diatoms, Algae, Water quality, Bluegreen algae, Green algae, Industrial wastes, Detrgents.

Onondaga Lake, New York, a heavily polluted, saline lake, was surveyed in 1975-1977 after an effort to reduce pollution and eutrophication several years earlier. In spring, diatoms and flagellates were common early in the season and were replaced later by chlorococcalean green algae. During the summer Chlorella vulgaris, Scenedesmus obliquus, Scenedesmus quadricauda and Cyclotella glomerata were abundant. In 1977 a late June die-off occurred. By September algae were decreasing in number, reaching a winter low of 10,000 cells per ml by winter. Blue green algae were relatively unimportant, unlike in years prior to 1972, when they caused late summer blooms. Enrichment studies indicated that availability of P to green algae and silica to diatoms may have affected their periods of dominance. (Cassar-FRC)
W81-05130

GROWTH OF PSYCHROPHILIC AND MESOPHILIC, AQUATIC BACTERIAL ISOLATES AT THE ENVIRONMENTAL TEMPERATURE,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
J. S. Kaminski, and G. D. Ferroni.
Water Research, Vol 14, No 7, p 815-820, July, 1980. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Aquatic bacteria, *Temperature, *Lakes, *Sediment-water interfaces, Sampling, Laboratory tests, Isolation, Seasonal fluctuations, Systematics.

The quantification of facultative psychrophiles, obligate psychrophiles, and mesophiles in sediment-water interface samples from a highly productive Canadian freshwater lake was undertaken to relate their numbers to environmental temperature at the time of sampling. Bacteria were isolated at two degrees and 37 degrees to represent extremes of seasonal temperatures that the lake normally experiences. When the in situ temperature was nine degrees, 80.4% of the bacteria isolated were mesophiles. The remaining 19.6% of the bacteria were facultative psychrophiles, with no detection of obligate psychrophiles. Many of the facultative psychrophiles were able to grow at 37 degrees. Of the mesophiles, nine distinct working types were found. Eleven distinct psychrophiles were detected which were more versatile than mesophiles in regard to utilization of the substrates. No direct relationships were found between the numerical predominance and growth rate at the environmental temperature when the growth of the psychrophilic and mesophilic types at the in situ temperature and at the time of sampling were compared. (Geiger-FRC)
W81-05151

THE APPLICATION OF BATCH BIOASSAY TECHNIQUES TO THE STUDY OF SALINITY TOXICITY TO FRESHWATER PHYTOPLANKTON,
Utah Water Research Lab., Logan.
M. L. Cleave, D. B. Porcella, and V. D. Adams.
Water Research, Vol 15, No 5, p 573-584, May, 1981. 2 Fig, 10 Tab, 28 Ref.

Descriptors: *Salt tolerance, *Bioassay, *Phytoplankton, Algae, Salinity, Lake Powell, Utah, Toxicity, Salts, Sodium compounds, Potassium compounds, Calcium compounds, Magnesium compounds, Sulfates, Chlorides, Bicarbonates, Selenastrum, Synedra, Diatoms, Freshwater algae.

The effect of salinity additions on the growth of freshwater algae was studied using batch bioassays. Test algae were Selenastrum capricornutum, Printz, and Synedra delicatissima var. angustissima, and indigenous diatom from Lake Powell. Salts used were chlorides and sulfates of Na+, K+, Mg(2+), and Ca(2+), as well as NaHCO3 and KHCO3. Selenastrum was more sensitive to increased salinity than was salinity-acclimated Selenastrum. Synedra was least sensitive. Mg was more toxic than other cations to both species. Sulfate was toxic to Selenastrum, and bicarbonate was most toxic to Synedra. A salinity of 0.05N in Lake Powell would suppress the growth of the native Synedra. It is unlikely that the salinity would reach this level at the current costs of agricultural water. A shift of algal populations to a less desirable blue-green species would occur at lower salinities. (Cassar-FRC)
W81-05157

ISOTOPE TRACER METHODS FOR INVESTIGATIONS OF NITROGEN DEFICIENCY IN CASTLE LAKE, CALIFORNIA,
California Univ., Davis. Div. of Environmental Studies.
R. P. Axler, and C. R. Goldman.
Water Research, Vol 15, No 5, p 627-632, May, 1981. 2 Fig, 3 Tab, 34 Ref.

Descriptors: *Phytoplankton, *Nitrogen compounds, *Isotopic tracers, Algae, *Castle Lake, California, Nutrient requirements, Molybdenum, Nitrates, Productivity, Photosynthesis.

The response of phytoplankton to nitrogen enrichment was studied in the subalpine Castle Lake, California, which has low productivity, molybdenum deficiency, and low levels of dissolved inorganic nitrogen (less than five micrograms N per liter) and phosphorus (less than one microgram per liter). C14 labeled bicarbonate, N15 labeled ammonium, N15 labeled nitrate, and N13 labeled nitrate were used as tracers to determine the rates of inorganic C and N uptake by the phytoplankton. Results showed that the phytoplankton were N-deficient during the growing season, nitrate uptake being regulated by the availability of nitrate and molybdenum, and potentially by the assimilation of ammonium. During the early part of the growing season, prior to mid-July, N-enrichment enhanced photosynthesis. At midseason the response was initially negative, but after 2-3 days it was positive. This suggests that inhibition of inorganic C uptake upon N enrichment does not necessarily preclude N-deficiency. (Cassar-FRC)
W81-05158

IMPORTANCE OF CO2 LOSS IN LAKE QUALITY PREDICTIONS,
R. A. Chadderton.
Water Resources Bulletin, Vol 17, No 2, p 307-309, April, 1981. 2 Fig, 5 Ref.

Descriptors: *Water quality, *Carbon dioxide, Lakes, Model studies, Acid mine drainage, Acidity, Air-water interfaces, Interfaces.

The purpose of this paper is to describe a method for estimating the importance of the mass transfer of carbon dioxide across the air-water interface for the case of lake modeling. The impact of carbon dioxide transfer on water quality of lake effluent depends on tributary concentrations and flow rates, initial pH of the water, and the effective mass transfer coefficient. Charts are developed for preassigned allowable errors in acidity and pH due to neglected gas transfer. Data from three reservoirs are related to the charts to estimate the relative importance of carbon dioxide transfer. In cases for which errors caused by neglected carbon dioxide loss would be within acceptable limits, a significant reduction in modeling effort can be achieved. (Baker-FRC)
W81-05180

OPTICAL MEASUREMENTS FOR BIOMASS DETERMINATION IN LIMNOLOGICAL STUDIES OF EUTROPHICATION,
Hydroconsult S.R.L., Asuncion (Paraguay).
J. A. Fitzpatrick, and J. F. Facetti.
Water, Air, and Soil Pollution, Vol 15, No 2, p 169-172, 1981. 1 Tab, 7 Ref.

Descriptors: *Biomass, *Eutrophication, *Limnology, Benthos, Aquatic productivity, Aquatic life, Phytoplankton, Lakes, Reservoirs, Analytical techniques.

A description is offered of an optical technique for determining phytoplankton biomass in lakes and reservoirs. The absorption coefficient can be calculated by making measurements of light intensity over relatively short intervals of depth. A determination of biomass can then be made. A good degree of correspondence was noted between values of the biomass calculated using this procedure and other methods of sampling. This procedure is rapid, and the results are given without the need for transporting water samples to a laboratory to make microscope cell counts. (Baker-FRC)
W81-05181

THE RELATIVE CONTRIBUTION OF AQUATIC MACROPHYTES AND THEIR EPIPHYTES TO THE PRODUCTION OF MACROPHYTE BEDS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. Cattaneo, and J. Kalff.
Limnology and Oceanography, Vol 25, No 2, p 280-289, March, 1980. 4 Fig, 6 Tab, 37 Ref.

Descriptors: *Aquatic plants, *Production, *Epiphyton, *Eutrophication, *Macrophytes, *Phosphorus compounds, Phytoplankton, Diatoms, Lake Memphremagog, Algae, Aquatic algae, Lakes, Nutrients, Water pollution effects.

The relative in situ productivity of macrophytes (principally Myriophyllum spicatum and Potamogeton richardsonii) and their undisturbed epiphytes were investigated as a function of season, species of macrophyte, depth below the surface, and eutrophic state in lake Memphremagog, Quebec. Production of both loose and adhering epiphytes was high in June (30-62% of total productivity), declined sharply in midsummer (2-4%) and increased in autumn (20-60%). Loose epiphyte cover was always greater on M. spicatum (4-13% in midsummer) than on P. richardsonii and even less on Vallisneria americana (1-2% midsummer). This may be a function of the leaf morphology. Macrophyte beds in deeper waters had a higher epiphytic cover than those in shallow water; on any given plant the epiphytes were more numerous on the plant surfaces closer to the water surface. Total phosphorus correlated with both tight and loose epiphyte production, 48-53% at the nutrient-rich inflow and 4-13% at the phosphorus-poor McPherson Bay. At lower total P, epiphyte production was less, and macrophyte production was greater. (Cassar-FRC)
W81-05197

USE OF CHLOROPHYLL-SECCHI DISK RELATIONSHIPS,
Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 7C.
W81-05200

PHOTOSYNTHESIS AND COCCOLITH FORMATION: INORGANIC CARBON SOURCES AND NET INORGANIC REACTION OF DEPOSTION,
Duke Univ. Durham, NC. Dept. of Zoology.
C. S. Sikes, R. D. Roer, and K. M. Wilbur.
Limnology and Oceanography, Vol 25, No 2, p 248-261, March, 1980. 7 Fig, 2 Tab, 48 Ref.

Descriptors: *Coccolith, *Calcium carbonate, *Photosynthesis, Carbon dioxide, *Algae, Adaptation, Lakes.

Several authors propose that the formation of calcium carbonate coccoliths by algae represents a

photosynthetic adaptation for the use of bicarbonate. This hypothesis was evaluated by two new methods using the coccoliths, Coccolithus huxleyi and Cricosphaera carterae. In the first method C14 labeled carbon dioxide and bicarbonate are added to buffered cultures and the carbon fixation measured at 10 second intervals for two min. In the second method, shifts in pH and alkalinity resulting from carbon fixation by cells in liquid cultures are assessed and the values compared to measurements of C14 incorporation in photosynthesis and carbonate deposition. Several alternative mechanisms explaining the data are discussed. It is concluded that the formation of coccoliths promotes photosynthesis by increasing the supply of carbon dioxide. However, the carbon dioxide resulting from carbonate deposition appears to enter the cell as bicarbonate, as does carbon in coccoliths. Photosynthesis promotes calcification by removing acidic carbon dioxide from the deposition site, enhancing crystal growth. Coccolith formation is responsible for the upward pH shifts usually attributed to photosynthesis. (Cassar-FRC)
W81-05223

AN EVALUATION OF AN UNATTENDED CURRENT AND TEMPERATURE PROFILER FOR DEEP LAKES,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 7B.
W81-05225

AN OPTO-ELECTRONIC SEDIMENT DETECTOR AND ITS USE IN THE CHEMICAL MICRO-PROFILING OF LAKES,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7B.
W81-05229

USE OF LANDSAT DATA TO IMPROVE THE WATER BUDGET COMPUTATION IN LAKE OKEECHOBEE, FLORIDA,
Agricultural Research and Education Center, Belle Glade, FL.
For primary bibliographic entry see Field 7B.
W81-05255

PHOTOSYNTHETIC CAPACITY MEASURED BY DCMU-INDUCED CHLOROPHYLL FLUORESCENCE IN AN OLIGOTROPHIC LAKE.
Freshwater Biological Association, Windermere (England).
W. F. Vincent.
Freshwater Biology, Vol 11, No 1, p 61-78, 1981. 13 Fig, 1 Tab, 52 Ref.

Descriptors: *Photosynthesis, *Oligotrophic lakes, *Chlorophyll, Fluorescence, Lakes, Seasonal variation, Phytoplankton, Stratification, Great Britain.

Algal photosynthesis in natural plankton communities has traditionally been estimated by in situ 14C-HC03 uptake or by oxygen production, but this approach is not very useful for comparative purposes. This study adopted an in vivo fluorescence assay to measure the potential photosynthetic capacity of an oligotrophic phytoplankton assemblage under defined conditions. Monthly samples were taken from Wastewater, an oligotrophic lake in Great Britain, over a 1 year period to compare the seasonal and vertical extents of floristic and physiological variation in the phytoplankton assemblage. Cellular photochemical capacity was measured by in vivo chlorophyll fluorescence before and after addition of the photosynthetic inhibitor 3(3,4-dichlorophnyl)-1,1-dimethyl urea (monuron, DCMU). The cellular photochemical capacity index proved useful in defining an activity coefficient for the chlorophyll levels measured in boiling methanol extracts. Large variations in the cellular photochemical capacity over time or depth were generally correlated with major shifts in phytoplankton species composition. The variations in both cellular photochemical capacity and floristic composition of the phytoplankton assemblage were as great over depth during a period of stratification as they were over time throughout the year. (Carroll-FRC)
W81-05265

FERTILIZER FLUX INTO TWO FLORIDA LAKES VIA SEEPAGE.
Florida Univ., Gainesville. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 5B.
W81-05276

VERTICAL DISTRIBUTION OF THE ZOOBENTHOS IN SOUTHEASTERN LAKE MICHIGAN WITH EVIDENCE OF SEASONAL VARIATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, and A. Robertson.
Freshwater Biology, Vol 11, No 1, p 87-96, 1981. 5 Fig, 1 Tab, 35 Ref.

Descriptors: *Benthic fauna, *Vertical distribution, *Seasonal variation, Lakes, *Lake Michigan, Michigan, Substrates.

The depth to which the benthic fauna organisms penetrate the sediments is important to an understanding of the role that they play in the exchange of nutrients, dissolved gasses, and other materials between sediments and the overlying waters. This study examined the vertical distribution of all benthic organisms in the sandy nearshore environment of southeastern Lake Michigan and the extent of seasonal variation in that distribution. Monthly sampling was conducted between May and November, 1976. The zoobenthos could be divided into two categories: one in which the majority of the population occurred in the upper 1 centimeter of substrate, and one in which the majority of the population occurred deeper. The former group consisted of such forms as Pontoporeia, naidids, chironomids, cyclopoids, harpacticoids, cladocerans, turbellarians, ostracods, rotifers, sphaeriids, and gastropods, all of which were rarely found below 2 centimeters depth. Forms found deeper in the sediments were immature tubificids without hair setae, Stylodrilus heringianus, nematodes, and tardigrades, which decreased in numbers with increasing vertical depth, with the exception of the tardigrades. Seasonal variations in the vertical distribution of these four infaunal groups were considerable. These seasonal variations were accompanied by differences in the depth of the detrital layer. The forms were found deeper when the detrital layer was very thin or absent in the autumn. It appears that changes in food availability at the sediment surface were the major factor leading to the observed vertical distribution patterns of this infaunal group. The lack of competition from and/or predation by taxa restricted to the upper sediments may also have contributed to the preference for the deeper layers in the autumn. (Carroll-FRC)
W81-05284

RESERVOIR CIRCULATION AND MIXING,
Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, T. S. Hedges, and D. Pateman.
Aqua, No 4, p 71-75, April, 1980. 6 Fig, 1 Tab, 2 Ref.

Descriptors: *Reservoirs, *Mixing, *Water circulation, *Algae, Stagnant water, Reynolds number, Inlets, *Liverpool, England.

Algae have presented a problem in Liverpool's two storage reservoirs during calm summer weather. Improved mixing of the water in these reservoirs with the aid of inlet jets was proposed to remove stagnant areas in which the same water remained for long periods of time, allowing the algae to grow. Physical models of the reservoirs were built to permit specific study of the inlet-outlet factor. Dye photography, surface float tracking, fluorimetry, and electrical conductivity were used to assess circulation patterns and mixing. Photographs of 18 runs using dyes depicted mixing and circulation and showed that mixing is dependent on the jet Reynolds number and the reservoir aspect ratio (the horizontal dimension of the reservoir divided by the average depth of water). The study indicated that the common practice of exaggerating the vertical scales of models of shallow reservoirs may be undesirable. (Cassar-FRC)
W81-05328

2J. Erosion and Sedimentation

ECOLOGICAL ASPECTS OF AGRICULTURAL POLICY,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
D. Pimental, and S. Pimentel.
Natural Resources Journal, Vol 20, No 3, p 555-585, July, 1980. 1 Fig, 1 Tab, 183 Ref.

Descriptors: *Soil erosion, *Soil conservation, *Agriculture, Erosion control, Public policy, Sedimentation, Political aspects, Federal jurisdiction, Federal programs, Agricultural runoff.

This article reviews Federal agricultural policies with respect to land conservation and pesticide use. Soil erosion has destroyed the potential for food production on several million accres of farmland in the United States and has removed at least one third of the topsoil on the cropland remaining in use, reducing its productivity. Erosion affects crop productivity through selective removal of plant nutrients and organic matter by wind and water; removal of organic matter and the finer soil particles by wind and water, resulting in compaction of the remaining soil; gross removal of topsoil; and increased water runoff, resulting in decreased water availability to crops and increased likelihood of flood damage. Erosion by water results in the deposition of about four billion tons of soil in U.S. waterways each year, with about 75 percent of this soil from agricultural lands. About 75 percent of the waterborne sediments settle in reservoirs, rivers, and lakes, while the remaining 25 percnt is deposited in the oceans. Nitrogen, phosphorus, potassium, and pesticides in the soil sediments from agricultural lands adversely affect stream and lake fauna and flora. In addition, the suspended sediments in streams may diminish the productivity of aquatic ecosystems due to a reduction in light penetration. Erosion by water results in the loss of about three billion tons of soil each year, with erosion by wind resulting in the loss of an additional billion tons. Changes in agricultural practices can affect the levels of soil erosion positively or negatively. Federal soil conservation legislation has authorized the expenditure of billions of dollars to help farmers control erosion and preserve topsoil. Technical and economic assistance are offered through the soil Conservation Service and the Agricultural Stabilization and Conservation Service. However, these programs are voluntary and refrain from imposing soil loss restrictions and have been generally ineffective in reducing erosion of agricultural lands. (Carroll-FRC)
W81-05113

VARIATION OF KARMAN CONSTANT IN SEDIMENT-LADEN FLOW,
Tianjin Univ. (China). Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 8B.
W81-05238

SELF-FORMED STRAIGHT CHANNELS IN SANDY BEDS.
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8B.
W81-05264

FIELD OBSERVATIONS AND FLUME EXPERIMENTS ON THE NATURE OF COMET MARKS.
Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
For primary bibliographic entry see Field 7B.
W81-05268

THE SORPTION OF SOLUBLE PHOSPHORUS BY SOIL MATERIAL DURING TRANSPORT IN RUNOFF FROM CROPPED AND GRASSED WATERSHEDS,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
For primary bibliographic entry see Field 5B.
W81-05272

SAND TRANSPORT AND BEDFORM PATTERNS ON THE CONTINENTAL SHELF BETWEEN DURBAN AND PORT ELIZABETH (SOUTHEAST AFRICAN CONTINENTAL MARGIN),
Institute of Oceanology, Rondebosch (South Africa).
For primary bibliographic entry see Field 7B.
W81-05323

2K. Chemical Processes

CHANGES IN SOLUTION OF FOREST SOILS WITH WATERLOGGING AND THREE LEVELS OF BASE SATURATION,
Southern Forest Experimental Station, New Orleans, LA.
W. H. McKee, Jr.
Soil Science Society of America Journal, Vol 44, No 2, p 388-391, March/April, 1980. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Forest soils, *Chemical properties, Soil types, Solubility, Waterlogging, Acidity, Saturated soils, Ion transport, *Ion exchange.

This study investigated changes in chemical properties of soil solution systems in relation to soil reduction on three forest soils with a wide range in exchange properties. Soils differed in pH response to base saturation and waterlogging. Initial pH values found before increasing base levels averaged 4.73 for silt loam, 5.10 for Caddo silt loam, and 4.70 for Gore silt loam. Redox values remained low throughout waterlogging, with voltage values between -82 and -356 mV. Values before waterlogging were erratic and ranged from 400 to 800 mV. Exchangeable cation levels generally increased with increased base saturation, by 2.36 to 6.14 meq/100 g for medium base saturation and 3.70 to 10.86 meq/100 g for high base saturation treatments at the start of waterlogging treatments. Soil pH increased with exchangeable Ca levels. Cation levels in solution were altered by both base saturation and waterlogging. Treatment response varied with soils, and no specific pattern was noted. The major impact of ion pairing on restricting nutrient availability appears to be at low base saturation levels, where higher percentages of the divalent cations in solution are in the paired bicarbonate form. (Baker-FRC)
W81-05142

IMPORTANCE OF CO2 LOSS IN LAKE QUALITY PREDICTIONS,
For primary bibliographic entry see Field 2H.
W81-05180

SEDIMENT-WATER CHEMICAL EXCHANGE IN THE COASTAL ZONE TRACED BY IN SITU RADON-222 FLUX MEASUREMENTS,
North Carolina Univ. at Chapel Hill.
C. S. Martens, G. W. Kipphut, and J. Val Klump.
Science, Vol 208, No 4441, p 285-288, April, 1980. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Chemical properties, *Coastal waters, *Sediments, Radon-222, *Cape Lookout Bight, *North Carolina, Methane, Ammonium, Radon, Benthic environment.

In benthic chambers in Cape Lookout Bight, a small marine basin on the North Carolina coast, in situ radon-222 flux experiments were conducted. Earlier field studies of the exchange of CH4 and NH4+ between the sediment and water in this area have yielded summertime chemical fluxes more than three times greater than those predicted on the basis of molecular diffusion as calculated from various equations. Two alternative hypotheses were generated to explain the enhanced transport from nearshore sediments. The direct in situ Rn-222 fluxes were used to determine which hypothesis was correct. Radon fluxes were measured by monitoring concentration changes in diver-emplaced benthic chambers with known water volume and sediment surface area coverage. Results allowed the conclusion that enhanced transport in this case was associated with the abiogenic bubble tube structures. Enhanced sediment-water chemical exchange could therefore occur in organic-rich coastal sediments in the absence of macoinfaunal irrigation and current-induced physical mixing. Radon-22 was seen as an excellent in situ tracer for such processes in the coastal zone. (Baker-FRC)
W81-05185

THE EFFECTS OF DIFFERENT MAGNESIUM:CALCIUM RATIOS AND SODIUM ADSORPTION RATIO VALUES OF LEACHING WATER ON THE PROPERTIES OF CALCAREOUS VERSUS NONCALCAREOUS SOILS,
Central Soil Salinity Research Inst., Karnal (India).
J. S. P. Yadav, and I. K. Girdhar.
Soil Science, Vol 131, No 3, p 194-198, March, 1981. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Saline soils, *Sodium adsorption ratio, *Calcareous soils, *Impaired water use, Magnesium, Calcium, Soil types, Irrigation water, Soil chemical properties, Chemical reactions, Hydraulic conductivity, Leaching, Semiarid lands, Calcium carbonate, India.

The effects of leaching waters of 80 milliequivalents per liter electrolyte concentration containing varying Mg:Ca ratios (2, 4, 8, and 16) and sodium adsorption ratios (SAR) (10, 25, and 50) on two different soil types were studied in the laboratory. A Karnal alluvial sandy loam soil was used in both calcareous and noncalcareous forms. In both soils, at a given SAR, the degree of dispersion increased and hydraulic conductivity decreased as Mg:Ca ratios in the leaching water increased. These effects were more pronounced at higher than at lower SAR values and were more pronounced in noncalcareous soils than in calcareous soils. The changes in degree of dispersion and hydraulic conductivity with increases in SAR at a given Mg:Ca ratio were greater in noncalcareous soils than in calcareous soils. The increasing Mg:Ca ratio also increased sodicity of both soil types, but especially in noncalcareous soil. (Cassar-FRC)
W81-05188

THE SOLUBILITY OF CALCITE AND ARAGONITE IN SEAWATER OF 35 PER THOUSAND SALINITY AT 25C AND ATMOSPHERIC PRESSURE,
Miami Univ., FL. Div. of Marine and Atmospheric Chemistry; and Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. W. Morse, A. Mucci, and F. J. Millero.
Geochimica et Cosmochimica Acta, Vol 44, No 1, p 85-94, 1980. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Calcite, *Calcium carbonate, *Solubility, Aragonite, Seawater, Physical properties, Water temperature, Atmospheric pressure.

Solubilities of several forms of calcite and aragonite in natural seawater of 35 per thousnad salinity at 25C and 1 atmosphere pressure were measured in closed bottles using equilibration periods up to 123 days. The solubility constant for calcite, 4.39 (+ or - 0.20) times 10 to the minus 7th power mol sq per kg sq, agreed with other recent values and remained constant after 5 days equilibration. Aragonite solubility decreased with time, becoming fairly constant after 20 days. A value of 6.65 (+ or - 0.12) times 10 to the minus 7th power mol sq per kg sq was determined for equilibration times greater than two months. This was considerably less than recent measurements which used equilibration times between a few hours and a few days. Synthetic, natural, and biogenic calcium carbonates of purity greater than 99% showed no statistical differences in solubility constants. Solid to solution ratio, contamination of aragonite with up to 10% calcite, and recycling of aragonite had no statistically significant influence on solubility when long equilibrium periods were used. (Cassar-FRC)
W81-05196

ORGANIC CARBON: OXIDATION AND TRANSPORT IN THE AMAZON RIVER,
Washington Univ., Seattle. Fisheries Research Inst.
J. E. Richey, J. T. Brock, R. J. Naiman, R. C. Wissmar, and R. F. Stallard.
Science, Vol 207, No 4437, p 1348-1351, March, 1980. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Carbon cycle, Rivers, *Amazon River, *Oxidation, *Organic carbon, Carbon, Spatial distribution, Temporal distribution.

Results are reported from two cruises of the R. V. Alpha Helix which assess for the first time spatial and temporal patterns in the organic carbon load of the Amazon River. Global riverine carbon fluxes are then estimated from this data. The findings suggest that retention and consequent oxidation are the major factors reducing seston concentration in the river and providing a uniform downstream export of organics. The findings also bear out the hypothesis that swamp hardwood forests and floodplains decompose fine particulate matter during periods of low water. This material is subsequently returned to the rivers by flooding water and surface runoff. The findings have a significant bearing on the interpretation of calculated losses of organic carbon from Amazonia and inputs to the ocean. If the transport and oxidation patterns observed in the Amazon hold for other major rivers, the contribution of river ecosystems to global carbon fluxes could be seriously underestimated. The current paper estimates that the total effective organic carbon efflux in the world's rivers might exceed 10 to the 15th power g/yr. This estimate of riverine carbon efflux is large enough to suggest that, since rivers are recipients of terrestrial drainage waters, they could provide a significant pathway for carbon released through human activities. (Baker-FRC)
W81-05221

THE DISSOLUTION KINETICS OF BIOGENIC CALCIUM CARBONATES IN SEAWATER,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
R. S. Keir.
Geochimica et Cosmochimi a Acta, Vol 44, No 2, p 241-252, 1980. 6 Fig, 8 Tab, 19 Ref.

Descriptors: *Calcium carbonate, *Solubility, Seawater, Sediments, Invertebrates, Calcite, Marine animals.

Dissolution rates were measured on synthetic calcium carbonate (calcite and aragonite powder) and biogenic carbonate from several sources--coccoliths (C. neohelis, E. huxleyi), foraminifera (Globigerinoides sacculifer, G. bulloides, and G. pachyderma), sediments from the Ontong-Java Plateau and the Rio Grande Rise, and pteropods. All samples followed the rate law, % dissolution per day = rate constant (1 - ratio of the total ion concentration product to the apparent solubility product of the carbonate mineral in question) to the nth power. The exponent n was 4.5 plus or minus 0.7, independent of species. The rate constant varied widely between samples and was sometimes inversely correlated with grain size. Dissolution rates of laboratory cultured E. huxley and C. neohelis were an order of magnitude lower than expected. (Cassar-FRC)
W81-05226

2L. Estuaries

THE ECOLOGY OF INTERTIDAL OYSTER REEFS OF THE SOUTH ATLANTIC COAST: A COMMUNITY PROFILE,
Louisiana State Univ., Baton Rouge.
L. M. Bahr, and W. P. Lanier.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-233041, Price codes: A06 in paper copy, A01 in microfiche. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/15, May, 1981. 105 p, 24 Fig, 8 Tab, 186 Ref, 1 Append.

Descriptors: *Estuarine environment, *Oysters, *Ecology, *Environmental effects, Intertidal areas, Reefs, Ecosystems, Coasts, Salt marshes, Wetlands, Water pollution effects, Salinity, Turbidity, Oyster reefs.

The American Oyster (Crassostrea virginica) is not only an extremely valuable commodity to man but is also a cosmopolitan, physiologically plastic, and ecologically interesting estuarine organism. One intriguing aspect of oyster behavior is its propensity to form massive, discrete, intertidal colonies, or reefs. In the South Atlantic Bight, oyster reefs occur in close association with extensive salt marshes. Mature reefs are stabilizing influences on erosional processes and may modify long-term changes in tidal stream flow and overall marsh physiology. The extent of the physical influence of reefs is a function of the average relative proportion of reef area to total intertidal area in a given drainage basin. Another aspect of the ecosystem value of oyster reefs relates to reefs being stable islands of hard substrate in an otherwise unstable soft muddy environment. Because oysters in reefs apparently live close to their stress tolerance threshold, further perturbation by man can easily destroy the entire reef community. Reefs are particularly susceptible to artificial hydrologic changes, such as those that follow the impoundment or diversion of rivers or streams. Reef oysters are susceptible to the increasing array of man-made chemicals and heavy metals becoming more prevalent in coastal waters, and are also vulnerable to eutrophication. Oysters tolerate high levels of turbidity, but increased sedimentation on top of natural levels can smother them. Long-term effects of increasing freshwater pumping may pose a problem more serious than pollution for the marsh oyster reef system, because of changes in salinity. (Moore-SRC)
W81-05039

DESCRIPTIVE WATER QUALITY FOR THE ATCHAFALAYA BASIN, LOUISIANA,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 6G.
W81-05052

FLUSHING STUDY OF SOUTH BEACH MARINA, OREGON,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 6A.
W81-05096

A NEW METHOD FOR ESTIMATING PHYTOPLANKTON GROWTH RATES AND CARBON BIOMASS,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W81-05182

SEDIMENT-WATER CHEMICAL EXCHANGE IN THE COASTAL ZONE TRACED BY IN SITU RADON-222 FLUX MEASUREMENTS,
North Carolina Univ. at Chapel Hill.
For primary bibliographic entry see Field 2K.
W81-05185

AVOIDANCE OF DREDGE SPOIL BY HERRING (CLUPEA HARENGUS HARENGUS),
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
D. W. Johnston, and d. J. Wildish.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 307-314, March, 1981. 1 Fig, 6 Tab, 9 Ref.

Descriptors: *Dredging, *Suspended sediments, *Fish behavior, Herring, Sediments, *Estuaries, Water pollution effects, Miramichi estuary, *New Brunswick.

The effects of a proposed dredging operation in the Miramichi estuary, New Brunswick, on juvenile herring were studied in sediment avoidance experiments. The poorly sorted sediment contained 3.33% organic carbon. Avoidance thresholds were as follows: suspended sediment, 9-12 mg per liter; suspended cellulose particles, 14-16 mg per liter; and, contrary to expectation, sediment with soluble organic compounds removed, 4.8 mg per liter. Although herring were found to have a visual perception limit of 0.00029 lux of white light, fish in this experiment had a partial inhibition of avoidance behavior at the lowest light level tested, 0.4 lux (sediment concentration 9.3-12.7 mg per liter). Red light masked the avoidance response. At 9.5 mg per liter and 43.0 lux, white light avoidance was 22% and red light, 6%. (Cassar-FRC)
W81-05211

GRAZING OF ACARTIA HUDSONICA (A. CLAUSI) ON SKELETONEMA COSTATUM IN NARRAGANSETT BAY (USA): INFLUENCE OF FOOD CONCENTRATION AND TEMPERATURE,
Rhode Island Univ., Kingston. Oceanography Graduate School.
E. E. Deason.
Marine Biology, Vol 60, No 2/3, p 101-113, 1980. 8 Fig, 7 Tab, 67 Ref.

Descriptors: *Grazing, *Zooplankton, *Thermal stress, Microorganisms, Estuaries, Eutrophication, *Narragansett Bay, Temperature effects, Phytoplankton, Aquatic plants, Plankton.

This study examines the effects of cell concentrations and temperature on the grazing of Skeletonema costatum by thermally acclimated adult Acartia hudsonica during the spring of 1976. The influence of grazing on S. costatum populations in Narragansett Bay during 1972 through 1977 is also estimated. It was noted that the increase in temperature throughout the spring in Narragansett Bay had a major influence on grazing rates. The increase in maximum filtration rate with temperature was also indicated by the significant differences in the initial slopes of the ingestion curve at different temperatures. At higher food concentrations, the maximum ingestion rate, which is probably determined by the maximum rate of digestion and assimilation, also increased significantly with the temperature increases. Depressed filtration rates were noted about 16 degrees C, indicating the effect of thermal stress at the upper end of the temperature range. During the winter and early spring the study showed that usually less than 5% of the standing crop was consumed daily. A phytoplankton growth rate of only 0.1 division per day would be sufficient to maintain the population under these conditions. The importance of grazing increased in the spring with increasing temperature. It was concluded that a large proportion of the primary production of Narragansett Bay during the winter and spring is either utilized by microzooplankton or the benthos or washed out of the Bay. (Baker-FRC)
W81-05224

ON THE NUMERICAL MODELING OF COHESIVE SEDIMENT TRANSPORT,
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulic Structures.
P. D. Scarlatos.
Journal of Hydraulic Research, Vol 19, No 1, p 61-68, 1981. 6 Fig, 12 Ref.

Descriptors: *Numerical analysis, *Sediment transport, *Prediction, Erosion, Sediment erosion, Deposition, Sedimentation, Finite difference methods, Mathematical studies, Mathematical equations, *Estuaries, Tides.

The prediction of cohesive sediment movements under the action of tides in estuarine systems is an important factor in planning and design affecting these coastal areas. This paper discusses the development of a numerical model for the prediction of fine sediment transport, erosion, and deposition in a well-mixed one-dimensional estuary. Special attention is given to the improvement of the simulation of the source and sink terms. The rate of erosion is given as a function of the bed shear stress and the time, while the rate of deposition is given as a function of the bed shear stress, the initial undeposited concentration, and the time. The governing equation is solved numerically, with the discretization formed according to a finite differences scheme. The validity of the model was verified from actual field data for the Savannah, Georgia, estuary, which is a very complicated system. Parameters which need to be calibrated by field measurements before the model is used include the dispersion coefficient, the threshold value of the bed shear stress for deposition, the critical value of the bed shear stress for erosion, the time for 50 percent deposition of the depositable part of the sediment, the standard deviation, and two erosion parameters. Since time history is important in the computations, special attention must be given to the boundary and initial conditions. Information on the velocities and the heights of the tidal hydrodynamics field of the estuary must also be provided. (Carroll-FRC)
W81-05258

AEROMONAS HYDROPHILA: ECOLOGY AND TOXIGENICITY OF ISOLATES FROM AN ESTUARY.
Maryland Univ., College Park. Dept. of Microbiology.
J. B. Kaper, H. Lockman, R. R. Colwell, and S. W. Joseph.
Journal of Applied Bacteriology, Vol 50, No 2, p 359-377, April, 1981. 1 Fig, 6 Tab, 81 Ref.

Descriptors: *Estuaries, *Microorganisms, *Human diseases, Toxins, *Bacteria, Aeromonas hydrophila, *Chesapeake Bay, Sediments, Water analysis, Seasonal variation, Temperature, Toxicity, Public health, Distribution patterns.

The major objective of this research was to determine the distribution of Aeromonas hydrophila in the estuarine environment and to examine selected strains for toxigenicity, in order to assess the public health significance of its occurrence in the environment. Water samples were collected at stations located in the Chesapeake Bay between May 1978 and April 1979. The upper 10 cm of sediment was also sampled. A hydrophila was isolated from samples collected at nearly every station included in the study at counts ranging from less than 0.3/1 to 5000/ml of water and up to about 460/g of sediment. Highest counts were obtained in areas where the total viable counts and coliform counts were also high. A distinct seasonal cycle was noted for A. hydrophila in the Chesapeake Bay. Counts for water samples decreased from autumn to winter and rose again in the spring. Population in sediment samples did not show such a definite seasonal shift. These fluctuations were temperature dependent. Of the 116 isolates tested, 83 (71%) demonstrated cytotoxicity in the Y-1 cell assay. The public health aspects of A. hydrophila in recreational waters are important, as the role of water in the transmission of A. hydrophila has been repeatedly demonstrated. (Baker-FRC)
W81-05275

TIDALLY-INDUCED RESIDUAL CURRENTS IN LONG ISLAND AND BLOCK ISLAND SOUNDS,
Naval Underwater Systems Center, New London, CT.
J. P. Ianniello.
Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 177-191, 1981. 6 Fig, 22 Ref.

Descriptors: *Tidal currents, *Estuaries, *Mathematical models, *Long Island Sound, *Block Island Sound, Flow channels, Flow characteristics, Water currents, Mathematical studies, Predictions.

The contribution of steady currents driven solely by the non-linear interactions of the first order tides to the estuarine circulation in tidal channels has been investigated using both analytic and numerical models. The agreement between observed and theoretically-predicted non-linearly-induced residual currents has also been investigated. The sensitivity of the second order solution to model assumptions when realistic bounds are placed on

the first order solution was examined. The nonlinear theory was applied to the Long Island Sound-Block Island Sound tidal channel in order to learn about the estuarine circulation and to test the validity of the theory by comparing observed and theoretical results. Known first order tidal properties of the channel were matched using three different models, which were chosen to isolate the effects of the factors potentially controlling the second order currents, either breadth, depth, or eddy viscosity variations. The residual currents driven by these first order models were found to agree within a factor of about two, indicating that the model was not too sensitive to properly test these parameters. A region of strong surface flow divergence and bottom flow convergence centered at a sharp constriction in the channel was the outstanding structural feature of the tidally-induced residual currents predicted for the Long Island and Block Island Sounds. A review of Eulerian and Lagrangian observations in the channel provided indirect support for the theoretical results. (Carroll-FRC)
W81-05287

NUTRIENT DISTRIBUTION IN AN ESTUARY: EVIDENCE OF CHEMICAL PRECIPITATION OF DISSOLVED SILICATE AND PHOSPHATE,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, A. J. Bale, and R. J. M. Howland.
Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 205-216, 1981. 8 Fig, 1 Tab, 24 Ref.

Descriptors: *Nutrients, *Chemical precipitation, *Estuaries, Phosphates, Silicates, *Great Britain, Coastal waters, Nitrates, Salinity, Distribution patterns.

Although there is considerable experimental evidence indicating that non-biological reactions may contribute to the control of estuarine silicate and phosphate distribution, field demonstrations of non-conservative nutrient behavior which can be attributed unequivocally to such reactions are lacking. This paper reports the results of continuous autoanalytical recording of the axial distributions of dissolved nitrate, silicate, and phosphate in the influent freshwater and saline waters of the Tamar Estuary in south-west Great Britain. Both short-term variability and seasonal variability in the distributions were assessed. The recordings showed that, while nitrate was always essentially conserved throughout the upper estuary, the silicate-salinity and phosphate-salinity relationships consistently indicated a non-biological removal of these nutrients within the low salinity range. Due to the large short-term variability and rapid changes in turbidity, it was not possible to quantify the degree of removal precisely nor to correlate this with changes in such environmental properties as pH, turbidity, or salinity. (Carroll-FRC)
W81-05289

NITROGEN FIXATION IN INTERTIDAL ENVIRONMENTS OF THE TEXAS GULF COAST,
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
J. W. Gotto, F. R. Tabita, and C. van Baalen.
Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 231-235, 1981. 2 Tab, 13 Ref.

Descriptors: *Nitrogen fixation, *Intertidal areas, Marine algae, Algae, Estuaries, *Gulf of Mexico, *Texas, Sediments, Coastal waters.

Although high rates of acetylene reduction had previously been measured in submerged seagrass areas of the Texas Gulf coast, nitrogen fixation had not been reported from other types of coastal environments along the Gulf of Mexico. This paper reports the results of measurements of the in situ rates of acetylene reduction occurring in a variety of environments characteristic of the shallow coastal ecosystem of the area. Measurements were performed under both light and dark conditions and at all times of the year. The data demonstrate that nitrogen-fixing microorganisms are of widespread occurrence in these coastal environments and that nitrogen fixation can be shown to take place in situ using short-term assays. The reported level of combined nitrogen supply due to fixation in the algal mat samples represents a significant contribution to the coastal ecosystems. (Carroll-FRC)
W81-05290

MEASUREMENTS OF THE SHORT-TERM STABILITY OF INTERSTITIAL SALINITIES IN SUBTIDAL ESTUARINE SEDIMENTS,
Victoria Univ. (British Columbia). Dept. of Biology.
P. M. Chapman.
Estuarine, Coastal and Shelf Science, Vol 12, No 1, p 67-81. 1981. 13 Fig, 2 Tab, 24 Ref.

Descriptors: *Interstitial water, *Salinity, *Sediments, *Estuaries, Diurnal distribution, Measurement techniques.

Several studies have investigated the interstitial salinities of sediments. This paper examines how the rate and amount of surface water penetration varies with sediment type in subtidal estuarine sediments. Salinity variations in the interstitial and overlying water were measured both in diurnal field studies and in laboratory penetration experiments with natural cores using sediments collected from the Fraser River estuary, a salt-wedge estuary in British Columbia, Canada. Subtidal measurements were made at five stations in the estuary. The in situ studies indicated that the interstitial salinities of sediments containing a high proportion of silt were relatively constant despite large fluctuations in water column salinities. Interstitial salinities in sands, on the other hand, closely followed diurnal salinity variations in the water column. The results of the in situ and laboratory studies showed that the rate of exchange between interstitial and overlying water was affected by three major factors: the substrate type, the salinity gradient between the overlying and the interstitial waters, and the flow rate. Sediment composition is the single most important factor which should be monitored in studies of the temporal or spatial variability of interstitial salinities. (Carroll-FRC)
W81-05291

SOME EFFECTS OF THE DISCHARGE OF CHLORINATED SEWAGE, FROM A SHORT SEA-OUTFALL, ON INTERTIDAL MACRO-ORGANISMS,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
J. R. Wharfe, B. J. Hutchings, and P. E. Jowett.
Environmental Pollution (Series A), Vol 25, No 1, p 9-17, 1981. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Chlorination, *Aquatic life, Sewage, Outfalls, Wastewater treatment, Bacteria, Estuaries, Environmental effects, *Ecological effects, Chlorinated sewage discharge.

Results are presented of the first year of field trials during which ecological studies were undertaken in the vicinity of a chlorinated sewage discharge. The sewage is discharged after primary treatment via a short outfall to the Loughor Estuary. During the discharge period chlorine concentrations were adjusted to achieve an increased kill of bacteria. Samples were taken of mussels, winkles and F. vesiculosus. Concentrations of halogenated hydrocarbons were measured in the tissues of a range of organisms collected prior to chlorination, two and eight weeks after chlorination began and 2 and 5 months after chlorination stopped. No detectable effect was noted on the distribution nor abundance of intertidal organisms due to the chlorination of the sewage discharge. Tissue residue analysis indicated an accumulation of halogenated short chain hydrocarbons during the discharge period. Five months after chlorination had stopped, tissue concentrations were similar to those recorded prior to chlorination. (Baker-FRC)
W81-05294

INLET STABILITY SOLUTIONS FOR TRIBUTARY INFLOW DISCUSSION,
National Inst. of Oceanography, Panjim (India). Div. of Ocean Engineering.
A. J. Mehta, and P. Bruun.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW1, p 36-38, February, 1981. 1 Fig, 1 Ref.

Descriptors: *Estuaries, *Influent streams, *Mathematical models, Mathematical studies, Waves, Rainfall effects, Runoff, *India.

An equation for inlet stability for tributary inflow is discussed. The equation considers fresh water outflow, which makes it useful for the stability evaluation for estuarine entrances such as Chandipur, Kalingapatam, Machilipatam, Nizampatam, Ponnai, and others on the peninsular coast of India. In India, the monsoon climate is characterized by comparatively intense wave activity, large rates of littoral drift, and high river runoff. Some values for the equation for these areas of India are presented. They cannot be verified because no bathymetric measurements are available for the monsoon months. (See W80-02339) (Small-FRC)
W81-05320

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PROCESS AND AN INSTALLATION FOR THE TREATMENT OF WATER,
Eilandgebied Curacao, Willemstad (Netherlands Antilles). (Assignee).
For primary bibliographic entry see Field 5F.
W81-05085

MORPHOLOGY OF AROMATIC POLYAMIDE TYPE ASYMMETRIC REVERSE OSMOSIS MEMBRANES,
Academia Sinica, Dalian (China). Dalian Inst. of Chemical Physics.
C. Jiayan, B. Shuchun, Z. Xingda, and Z. Lingying.
Desalination, Vol 34, No 1/2, p 97-112, July-August, 1980. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Membranes, Desalination apparatus.

This paper reports the results of combined electron microscopic and optical microscopic observation of aromatic polyamide membranes prepared by thermal evaporation-gelation techniques. In the majority of cases the samples are treated by the method of critical point drying followed by observation with a scanning electron microscope. A micellar structure exists within the dense layers of these asymmetric membranes prepared with significant solvent evaporation. Various types of defects have been noted on the surfaces of some parts of such membranes. Due to the use of different membrane materials and preparation techniques, variations exist in structure in the cross-section of these membranes. Reverse osmosis performance was correlated not only with the degree of densification and integrity of the surface layer, but also with the structure of the cross-sections. Preliminary findings concerning the influence of casting conditions of the membranes on the morphology are discussed. (Baker-FRC)
W81-05193

USE OF THIN CHANNEL SYSTEMS FOR ULTRAFILTRATION AND HYPERFILTRATION,
Danish Sugar Corp., Nakskov. Krifttenknisk Lab.
W. K. Nielsen, and R. F. Madsen.
Desalination, Vol 34, No 1/2, p 113-130, July-August, 1980. 14 Fig, 6 Ref.

Descriptors: *Filtration, *Membranes, *Design criteria, *Desalination, Brackish water, Ultrafiltration, Hyperfilitration, Filters, Membrane processes.

The thin-channel system was one of the first systems developed for hyperfiltration. Later, a thin-channel system with short channels was devel-

oped, which proved to be excellent for hyperfiltration as well as for ultrafilitration. Thin-channel systems are especially suitable for concentration at high viscosities and high dry-substance contents, e.g., in the food industry. Efficiency of operation of membrane filtration systems is governed by design criteria such as conditions on the permeate side, membrane selection, visual inspection of membranes to ascertain need for replacement, design of the flow channel, selection of pressure and pressure difference, and prevention of 'dead areas'. Theoretical considerations for flow channel dimensioning have proven valuable in operation. New membrane types are being developed for specific applications. (Baker-FRC)
W81-05214

SELECTION OF MICROPOROUS MEMBRANES FOR OPTIMUM SEPARATIONS,
Nuclepore Corp., Pleasanton, CA.
H. W. Ballew, and M. C. Porter.
Desalination, Vol 34, No 1/2, p 3-9, July-August, 1980. 5 Ref.

Descriptors: *Desalination, *Filters, *Membrane filters, Screens, Microenvironment, Bacteria, Physical properties, Chemical properties.

The paper compares the physical structure, chemical resistance, retention and other performance characteristics of two basic types of microporous membranes commercially available, the screen type and the depth type. In order to achieve optimum results, the user must carefully consider all aspects of the separation procedure before selecting which type of membrane to employ. The most obvious structural difference in the two types is the pore structure - one is a screen and the other an absolute media possessing characteristics of both a screen and a depth media. As the tortuous pore membrane has much larger available surface area, it will in general hold a higher dirt load and therefore offer more throughput than the screen membrane. If, however, adsorption or absorption of small particles out of the filtrate is significant, one would choose the screen. Both membranes are non-migrating. The screen membrane is much stronger. However, the pore membrane is easier to handle than the thin film screen. Most nitrocellulose tortuous pore membranes will dissolve in acids, alcohols and bases. Polycarbonate screens have excellent chemical resistance to acids and alcohols, but dissolve in strong bases and halogenated hydrocarbons. (Baker-FRC)
W81-05215

LABORATORY EXPERIMENTS WITH HYPERFILTRATION MEMBRANES,
Heidelberg Univ. (Germany). Inst. fer Angewandte Physikalische Chemie.
W. Schneider, and O. Bauer.
Desalination, Vol 34, No 1/2, p 11-23, July-August, 1980. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Desalination, *Hyperfiltration, *Membrane processes, Mathematical studies, Laboratory tests, Reverse osmosis.

Laboratory tests were conducted using RO membranes, with the aim of discussing experimental results not covered by the mathematical relationships which represent the operating properties of hyperfiltration membranes. The knowledge concerning hyperfiltration processes has been expanded by this analysis. It was concluded that the concept of a structured membrane does not differ essentially from other models of an imperfect solution diffusion membrane. However, by tracing the separation to a combined action of the chemical properties process is transferred from the surface of the membrane into its interior. Several phenomena of membrane behavior can be explained through this approach. It is suggested that, in investigating these membrane properties, the excess properties which are considered to account for the model of action of a hyperfiltration membrane should be analyzed rather than the absolute amounts of transport and separation. (Baker-FRC)
W81-05216

LOW TEMPERATURES AND DISSOLVED GASES: TWO PROBLEMS IN SUBMARINE SEA WATER DESALINATION,
Munich Univ. (Germany, F.R.). Dept. of Chemical Engineering.
M. Hampe.
Desalination, Vol 34, No 1/2, p 35-56, July-August, 1980. 17 Fig, 4 Tab, 6 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Seawater, Brackish water, Saline water, Temperature, Water temperature, Dissolved oxygen, Nitrogen, Argon, Carbon dioxide, *Membrane processes.

In efforts to expand the usefulness of reverse osmosis for sea water desalination, the degree of permeability for water and the degree of rejection for the dissolved salts were investigated as they relate to temperature and depth of the sea. The gases dissolved in sea water were also investigated as they permeate the membranes. Their influence on desalination behavior was studied with special reference to the water throughput. Four different types of CTA membranes were studied regarding their rejections for sodium, potassium, magnesium and calcium, sulfate, chloride, total carbon dioxide, argon, oxygen, and nitrogen, as well as their volume fluxes in the temperature range of 0-20 C. In general the rejection of salt decreased with increasing temperature, while volume fluxes increased linearly with temperature increases. Volume fluxes were only slightly dependent on pressure at temperatures ranging from 0-5 C, but this dependence increases with a different slope depending on the pressure level when the temperature is raised. The formation of polymer water networks at low temperatures is discussed in an effort to explain these findings. Ionic constituents of sea water are rejected. Carbon dioxide is rejected at 95%. (Baker-FRC)
W81-05217

EVALUATION OF AN ION EXCHANGE SYSTEM REGENERATED WITH SEAWATER FOR THE INCREASE OF PRODUCT RECOVERY OF REVERSE OSMOSIS BRACKISH WATER PLANT,
Mekorot Water Ltd., Tel-Aviv (Israel).
M. Wilf, M. Konstantin, and A. Chencinsky.
Desalination, Vol 34, No 3, p 189-197, September, 1980. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Ion exchange, *Desalination, *Seawater, Brackish water, Reverse osmosis, Economic aspects, Calcium, Water treatment.

The feasibility of ion exchange softening of reject from a reverse osmosis brackish water desalting program, using seawater as a regenerant, was tested in a pilot plant on the Red Sea shore. The pilot plant consisted of a storage tank for the reverse osmosis reject stream, a pump, and an ion exchange column containing 45 liters of strong acid cation exchange resin. The experimental results showed that the calcium concentration in the reject was reduced from 1,400 parts per million to a level enabling further reverse osmosis desalting of the softened reject at 50 percent product recovery. A preliminary economic evaluation indicates that ion exchange pretreatment of the reject followed by reverse osmosis desalting should produce less expensive drinking water than could be obtained from an equivalent reverse osmosis seawater desalination system. This ion exchange pretreatment system is limited to coastal locations only. (Carroll-FRC)
W81-05218

3B. Water Yield Improvement

DEVICE FOR CLEANING, WIDENING AND REPAIRING WELLS OF DRINKING WATER AND IRRIGATION WATER,
C. F. Levoni, and G. P. Levoni.
U.S. Patent No 4,223,724, 14 p, 9 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, p 1316, September 23, 1980.

Descriptors: *Patents, *Water wells, *Cleaning, *Repairing, Irrigation wells, Water supply, Equipment, Well filters, Zone of saturation.

A device for cleaning, widening and repairing of wells comprises a pipe for supplying, through a valve, compressed-air into the well and a water and air discharge pipe coaxially surrounding the air supply pipe and terminating at its upper end with a bell airtightly welded to the periphery of the air supply pipe. The water and air discharge pipe at its upper part has a first port connecting with a water discharge pipe through a valve and a second port connnecting with an air discharge pipe through another valve. A head surrounds the upper portion of the water and air discharge pipe and at its upper end is airtightly welded to the periphery of the water and air discharge pipe, and at its lower end terminated in a flange detachably secured to the upper end of the well-jacket. The head has a third port connecting through a valve with a pipe for discharging and similar purposes. Moreover, there are provided two annular rubber diaphragms for defining in the depth of the well the zone in which the compressed-air has to be blown for widening the well and other elements to remove deposits, stones and putrid waters. Another device is provided for removal of the pebble gravel of the well-filter and earth blocks clogging the well-filter. (Sinha-OEIS)
W81-05081

THE IMPACTS OF CATCHMENT AFFORESTATION ON WATER SUPPLY INTERESTS,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 4A.
W81-05248

3C. Use Of Water Of Impaired Quality

HUMAN ENTERIC VIRUS SURVIVAL IN SOIL FOLLOWING IRRIGATION WITH SEWAGE PLANT EFFLUENTS,
Texas Univ. at San Antonio. Center for Applied Research and Technology.
B. P. Sagik, B. E. Moore, and C. A. Sorber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207426, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/1-80-004, June, 1980. 152 p, 20 Fig, 58 Tab, 71 Ref, 2 Append.

Descriptors: *Land disposal, *Wastewater irrigation, *Enteroviruses, *Groundwater pollution, *Coliforms, Bacteria, Bacteriophage, Public health, Effluents, Public health.

Sewage treatment removes many but not all viruses from the effluent. Therefore, a knowledge of the survival and fate of these viruses is important in assessing the health risk to farm workers and consumers of food crops and ground water in areas where domestic wastes are applied to the land. The wastewater treatment processes at Kerrville and Uvalde, Texas, were evaluated in terms of their efficacy in reducing human enteric viruses. Enteric viruses were reduced by greater than 99% at Kerrville and at least 99% at Uvalde. These waters are used for irrigation without disinfection. Soil samples at both application sites yielded fecal coliforms and bacteriophages. In addition, two confirmed enterovirus isolations were made at the Kerrville site. Lysimeters placed at 1.5 ft, 2.0 ft, and 4.5 ft depths at the Kerrville site yielded large numbers of bacteriophage isolates. Ten lysimeter samples yielded a total of 29 confirmed viral isolates. No confirmed virus isolations were made from any of the monitoring wells. The isolation of enteroviruses in water from lysimeters but not from the monitoring wells suggests that depth to groundwater should be a critical factor in the selection of irrigation sites. From data developed in this study, it appears that a depth of 4.5 ft is not sufficient for effective viral attenuation in soils. (Moore-SRC)
W81-05044

LONG-TERM EFFECTS OF LAND APPLICATION OF DOMESTIC WASTEWATER: CAMARILLO, CALIFORNIA, IRRIGATION SITE,
Stone (Ralph) and Co., Inc., Los Angeles, CA.
R. Stone, and J. Rowlands.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-225733, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-080, May, 1980. 280 p, 18 Fig, 36 Tab, 186 Ref, 8 Append.

Descriptors: *Land disposal, *Wastewater irrigation, *Groundwater pollution, Pathogens, Heavy metals, Nutrients, Salts, Leachate, Domestic wastes, Effluent, Crop yields, Coliforms.

The widespread application of treated wastewater for irrigation is limited primarily by uncertainties about the impacts of such use. In addition to costs, there is concern that the quality of our foodstuffs, land resources, and groundwater resources may be partially impaired due to residual contaminants present in the treated effluent. In order to assess the long-term impacts on crops, soils and groundwater resulting from irrigation with secondary-treated municipal effluent, test and control sites at Camarillo, California were selected as case studies for comparisons. Both sites produced row crops for human consumption and were irrigated primarily by the furrow method. The test site had been irrigated with effluent and the control site had been irrigated with conventional water for at least ten years. The concentrations of pathogens, nutrients, heavy metals and salts were determined in soils, groundwater, and crops from the test and control sites. The leachate, at the 50 and 100 cm depths, from the test site generally did not differ significantly from the control site leachate. Effluent land application proved an effective method of attenuating total organic carbon and phosphates. Total and fecal coliforms were effectively attenuated at both sites. Water quality criteria for total dissolved solids, sulfate, and nitrate were exceeded in test site monitoring wells essentially 100% of the time. The criteria were exceeded at various times for cadmium, chromium, and lead. The crop yield on the test site averaged 12% greater for tomatoes, and 4% greater for broccoli than on the control site over a 13 year period. The net profit per hectare on identical crops grown on the test site exceeded the profits for the control site by an average of $278 for tomatoes and $188 for broccoli. (Moore-SRC)
W81-05045

EFFECTS OF SLUDGE IRRIGATION ON THREE PACIFIC NORTHWEST FOREST SOILS,
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 5E.
W81-05051

GUIDELINES FOR WATER REFUSE,
Camp, Dresser and McKee Inc., Boston, MA.
J. F. Donovan, and J. E. Bates.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105017. Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/8-80-036, August, 1980. 115 p, 48 Fig, 12 Tab, 74 Ref, 3 Append.

Descriptors: *Water reuse, *Wastewater renovation, *Impaired water use, Water resources development, Planning, Recycling, Public participation, Economic aspects, Water pollution control, Legal aspects, Marketing, Water conservation.

In order to increase interest in and assist implementation of wastewater reuse for nonpotable purposes, guidelines have been developed to make water managers and resource planners aware of proven reuse possibilities. Perceived benefits in water reuse include: conservation of water; recycling of nutrients,; practical cost and energy savings; reduction in the discharge of pollutants; realization of other public priorities such as preservation of open space for aesthetic and recreation value; and encouragement of industrial recycling. Following a step-by-step approach provided in the guidelines, the water manager and resource planner can address the principle areas of concern in water reuse programs, including technology, economics, legal issues, institutional arrangements, markets, and public information. Case histories provide insight into actual reuse experience. Potential markets for reclaimed water include: groundwater recharge; recreation; environmental enhancement; crop irrigation; commercial nurseries; commercial aquaculture; landscape irrigation; fire protection; air conditioning; toilet-flushing; industrial cooling; boiler-feed; process water; and construction uses. (Moore-SRC)
W81-05060

THE EFFECTS OF DIFFERENT MAGNESIUM:CALCIUM RATIOS AND SODIUM ADSORPTION RATIO VALUES OF LEACHING WATER ON THE PROPERTIES OF CALCAREOUS VERSUS NONCALCAREOUS SOILS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2K.
W81-05188

TREATMENT PROCESSES TO MEET WATER REUSE REQUIREMENTS,
Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 5D.
W81-05194

WATER REUSE--LEARNING ABOUT THE EUROPEAN EXPERIENCE,
For primary bibliographic entry see Field 5D.
W81-05195

THE PREPARATION OF SEWAGE SLUDGES OF CONTROLLED METAL CONTENT FOR EXPERIMENTAL PURPOSES,
Water Research Center, Herts (England).
R. D. Davis, and C. H. Carlton-Smith.
Environmental Pollution, (Series B), Vol 2, No 3, p 167-177, 1981. 6 Fig, 12 Ref.

Descriptors: *Sludge, *Enrichment, *Agriculture, *Metals, Heavy metals, Plants, Cadmium, Nickel, Zinc, Copper, Nutrients, Land disposal.

A method of producing experimental sludges of controlled metal content by the pilot-scale treatment of metal-enriched sewage is described. Tests comparing the chemical extractability and availability to plants of metals in the experimental sludge with the same properties of metals in sludges collected from sewage-treatment works would indicate whether use of the experimental sludges in agricultural trials was justified. Sludge was prepared by a batch process which produced a cosettled or mixed sludge. The comparatively low suspended solids content of the crude sewage was increased by the addition of crude, domestic sludge with a dry solids content of 5%. Thus 15 liters of 4.5% sludge could be produced from 500 liters of enriched crude sewage. Sludges were prepared from sewage enriched with the acetate, chloride, sulfate or sulfide of cadmium or zinc and the sulfates of copper and nickel. Although the tests with chemical extractants provided useful evidence concerning forms of metals in sludges and sludge-soil mixtures, full examination of the availability of metals to crops requires plant tissue analysis. (Baker-FRC)
W81-05230

EFFECT OF WASTEWATER IRRIGATION AND LEACHING PERCENTAGE ON SOIL AND GROUND WATER CHEMISTRY.
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. B. Bole, J. M. Carefoot, C. Chang, and M. Oosterveld.
Journal of Environmental Quality, Vol 10, No 2, p 177-183, April-June, 1981. 7 Tab, 15 Ref.

Descriptors: *Wastewater irrigation, *Groundwater pollution, *Soil chemistry, Leaching, Crop production, Salts, Salinity, Municipal wastes, Impaired water use.

The effect of leaching percentages on soil and groundwater chemistry was investigated during six years of experimental irrigation with municipal wastewater. The crops were reed canary grass, alfalfa, and fallow. The municipal wastewater contained about 1300 mg/liter of salt, largely sulfates and bicarbonates of sodium, calcium, and magnesium. During the first two years, high leaching percentage rapidly reduced initial high salinity levels in the soil profile, but salinity levels increased during the last four years. The resultant salinity levels did not affect crop production. The soil under alfalfa had the highest salinity, while reed canary grass and fallow had lower and similar salinity. In the final year of the investigation, leaching percentage values were lowest for alfalfa at 9.3 and 29.2%, intermediate for reed canary grass at 17.4 and 33.1%, and highest for fallow at 22.7 and 33.9%. Leaching percentages were estimated from the soluble sodium concentration at the 90- to 150-cm depth of the soil profile. (Small-FRC)
W81-05274

THE PIPES OF AL'AIN.
For primary bibliographic entry see Field 5F.
W81-05349

3D. Conservation In Domestic and Municipal Use

RESIDENTIAL WATER CONSERVATION,
Colorado Univ., Boulder. Dept. of Civil Engineering.
J. E. Flack.
Journal of the Water Resources Planning, and Management Division, Processings of the American Society of Civil entineers, Vol. 107, No WR1, p 85-95, March, 1981. 7 tab, 15 ref.

Descriptors: *Water conservation, *Water demand, *Water consumption, Pricing, Domestic water, Urban planning, Water metering, Water rates, Water reuse, Flow control.

Increasing raw water development costs, higher standards for treated water, and scarcity of supplies have forced water utilities to encourage conservation. Methods of reducing water consumption in the residential sphere are structural (metering, flow control devices, recycling systems, reduced system-wide pressure, reuse of wastewater, and changes in horticultural particles); operational (leakage detection and repair and restricted use); economic (pricing policy, incentives, penalties, and demand metering); and socio-political (public education, laws, building code modifications). These conservation methods affect one another and are not strictly additive. Illustrations of these interactions and the resulting changes in water consumption are given for a 10,000 household community. The peak day to average day ratios remain the same under conservation programs. When demand drops, prices should be increased to prevent a loss of revenue. (Cassar-FRC)
W81-05102

IN PURSUIT OF WATER ECONOMY.
National Water Council, London (Enland).
R. White.
Water, No 37, p 2-4, March, 1981.

Descriptors: *Water conservation, *Great Britain, *Metropolitan water management, *Water management, Conservation, Economic aspects, Leakage, Water loss, Water conveyance, Water metering, Water use efficiency, Sanitary wastewater, *Municipal water, Public policy.

Water conservation efforts have received increased attention from the water industry in Great Britain in recent years. Although British consumers do not appear to be conspicuously wasteful in their use of water, several steps to improve water economy have been proposed and are being tested. Normal water economy measures should be designed to influence consumers to reduce water consumption without decreasing the level of service, in such a manner that savings in operating and capital costs

are greater than the costs of implementing the measures. Social costs and benefits must also be considered. Water conservation methods which are being investigated include control of underground leakage in water distribution systems, water metering, reduction of the amount of water used to flush toilets, reduction of the water consumption of clothes washers and dishwashers, and increased use of showers and spray taps. Current British legislation permits water authorities to make by-laws to prevent waste, undue consumption, misuse, or contamination of water supplied by the authorities. These by-laws should be revised to increase the emphasis on prevention of waste and undue consumption. Possible strengthening of the statutory control over the use of unsatisfactory water fittings should be investigated. (Carroll-FRC)
W81-05271

3F. Conservation In Agriculture

OPTIMIZATION OF WATER USE FOR FIELD CROP PRODUCTION IN THE UPPER MIDWEST,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
P. N. Walker, M. D. Thorne, E. C. Benham, and W. D. Goetsch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246258, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, University of Illinois, Research Report No 159, 1981. 60 p, 20 Fig, 12 Tab, 15 Ref. OWRT-B-120-ILL(4), 14-34-0001-9113.

Descriptors: *Water use, *Agriculture, *Irrigation, Drainage, Claypan, Corn, Soybeans, *Illinois, Midwest, Soil moisture, *Crop production, Comparison studies.

This project investigated combinations of both irrigation and drainage treatments in order to determine the best water management practices for field crop production in claypan soils in the upper Midwest. Four years of corn and one year of soybean yield data from forty field plots are presented. The irrigation treatments were sprinkler, furrow, and no irrigation; the drainage treatments were surface, subsurface, surface plus subsurface, and no drainage. The plots were located on a claypan soil in south-central Illinois. Sprinkler irrigation was provided by a solid set system. Furrow irrigation was done with gated pipes. The plots with surface drainage had a slope of 0.5%; the others were graded level. Subsurface drainage was provided by plastic tubing on 20-ft centers. Drainage water from the plots and surrounding areas was stored in ponds and recycled as irrigation water. The data indicate average corn yield increases of 13 and 50 bu/acre due to drainage and irrigation, respectively. Together, they act synergistically to produce an average yield increase of 92 bu/acre. This synergistic yield increase provides economic impetus to combining irrigation and drainage systems and storing drainage water in ponds or lakes for later use in irrigation. This combination will have the added effect of conserving water resources, of improving water use efficiency and downstream water quality, and of lessening downstream flooding.
W81-05001

THE ECONOMIC OPPORTUNITY TO IRRIGATE CORN AND SOYBEANS ON MIDWESTERN CLAYPAN SOILS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
W. L. Miller, R. L. Clouser, P. Eerhabor, and J. Sobek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246266, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 93, June, 1981. 44 p, 3 Fig, 16 Tab, 6 Ref. OWRT-B-120-ILL(3).

Descriptors: *Irrigation, *Claypan soils, *Irrigation economics, *Corn, *Soybeans, Sprinkler irrigation, Irrigable land, Water potential, Irrigation practices, Investment, Discount rates, Rate of return, Comparison studies.

The objectives of the research were to examine the profitability of dryland vs. irrigated corn and soybean production on claypan soils. This comparison was made for several different farm sizes and for grain farms as well as livestock and crop mixed farming situations. The results of this analysis show irrigation on claypan soils to result in higher net values of the annual discounted cash flows for farms of different sizes. In cases where 80 acre, 160 acre, and 640 acre farms were evaluated, the irrigated systems produced higher net returns to labor and management than did the dryland operations. The analysis were made for 4 and 12 percent rates of discount, and the relative ranks among systems are the same regardless which rate is used. These results indicate a potential exists for irrigation on small and medium size farms in claypan areas. The results only indicate potential because each farm situation must be evaluated on its own merits taking into consideration factors such as the distance from a water storage pond to the fields to be irrigated, labor availability during the irrigation season and access to capital to finance irrigation investments. The results indicate it appears to be worthwhile for the individual farmer operating on claypan soils to evaluate irrigation along with other alternative capital investments.
W81-05002

AUTOMATION OF SURFACE IRRIGATION: 15 YEARS OF USDA RESEARCH AND DEVELOPMENT AT FORT COLLINS, COLO.,
Science and Education Administration, Fort Collins, CO.
H. R. Haise, E. G. Kruse, and H. R. Duke.
Department of Agriculture Production Research Report No 179, February, 1981. 62 p, 54 Fig, 63 Ref, 1 Append.

Descriptors: *Surface irrigation, *Automation, *Agricultural engineering, *Irrigation engineering, Water use, Water management, Water conservation, Ditches, Pipelines, Flow control, Telemetry.

Automated irrigation has been developed as a response to concern for improved water utilization, more effective water management, scarcity of labor, and increasing energy costs, in succession over the years 1964 to 1979. Irrigation may be automated through the use of buried pipelines, ditches, and gated pipe and flumes, each of which can use a number of different valves and flow controllers. Automation of buried pipelines is not widespread, but pneumatic closures are being used. Ditches with pipe turnouts may be controlled at the inlet or outlet end. Flow in ditches may be controlled by ditch checks and jack-gate turnouts. Problems in automating surface pipe systems remain to be overcome but it is expected that automation of individual gates will be especially useful. Control of the system may be by tone telemetry by radio or by wire, mechanical controller (hydraulic and pneumatic), electromechanical controller (wire) and solid state electronic controller. The most recent development is a keyboard programmable controller capable of nearly unlimited selections of irrigated blocks and sequences for outlet discharge control. Related developments include: fluidic diverters; self-closing and regulating valves, self-propelled ditch irrigators. It is expected that automation of irrigation systems will become more efficient and widespread. (Brambley-SRC)
W81-05038

STATIONARY DROP OR FIN STREAM IRRIGATION SYSTEM FOR CITRUS ORCHARDS, FRUIT-TREES, VEGETABLES AND FODDER PLANTS,
W. La Scala, and G. Buttiglione.
U.S. Patent No 4,223,840, 6 p, 5 Fig, 6 Ref; Official Gazette of the United States Patent, Vol 998, No 4, p 1353, September 23, 1980.

Descriptors: *Patents, *Irrigation systems, *Distribution systems, Applications equipment, Pipes, Irrigation efficiency, Irrigation practices, Orchards, Vegetable crops, Fodder, Drop irrigation system.

An irrigation system for trees, vetegables, fodder plants and the like has a feeding network including main and secondary liquid distribution pipes, vertical pipes branched off the distribution pipes and connected substantially horizontal distribution tubes located above ground. Each such tube extends along a row of trees, or, in absence of trees, at predetermined mutual equal distances from other tubes. Each horizontal tube mounts liquid distribution cases, each positioned near a tree or, in absence of trees, at predetermined mutual distances. Each distribution case is provided with peripheral radial slots through which pass a variable number of small slightly flexible, downwardly depending tubes made of dark plastic. At least some of the small tubes have their outlet orifices placed at a predetermined distance above ground. (Sinha-OEIS)
W81-05077

CORNER WATERING CIRCLE MOVE,
Pierce Corp., Eugene, OR. (Assignee).
R. W. Bleakney.
U.S. Patent No 4,223,839, 11 p, 10 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, p 1353, September 23, 1980.

Descriptors: *Patents, *Irrigation systems, *Application equipment, *Sprinkler irrigation, Irrigation practices, Irrigation efficiency, Control systems.

A corner watering circle move is described in which a line move and sprinklers are stopped when the move comes to a corner portion of a field. An end section of the move is then swung to move coupling member into coupled engagement with a set coupling member. Water is supplied from the line through the coupling members to set sprinklers in the corner portion. After a predererermined spinkling time, the line is cut off from the coupling sections, the sprinklers on the line are started, and the end section is backed away from the set coupling member to a position aligned with the rest of the line. The movable coupling member is offset from the set coupling member and the line move is moved to the next corner portion. The sprinklers on the line have differential pressure valve actuated by a pilot line on the line to control water supply to these sprinklers. (Sinha-OEIS)
W81-05078

SELF-FLUSHING, CONSTANT FLOW EMITTER FOR A DRIP IRRIGATION SYSTEM,
S. Maria-Vittorio-Torrisi.
U.S. Patent No 4,223,838, 10 p, 10 Fig, 5 Ref; Official Gazette of the United States Patent Office. Vol 998, No 4, p 1352-1353, September 23, 1980.

Descriptors: *Patents, *Irrigation, *Application equipment, Irrigation practices, Irrigation efficiently, Irrigation operation and maintenance, Measurement, Drip irrigation.

An improved self-flushing, constant flow emitter is particularly suited for use with a drip irrigation system. The emitter includes an internal chamber having a discharge orifice and a resiliently supported plunger within the chamber adapted to responded to pressure changes for simultaneously metering a flow of water through the orifice and dislodging foreign matter from the orifice. One embodiment of the invention includes a spring-biased plunger having an abrasive surface for dislodging scale while another includes a foreshortened plunger supported by an axially deformed annulus characterized by a memory. (Sinha-OEIS)
W81-05079

DOSED DELIVERY DEVICE FOR LIQUIDS, PARTICULARLY FOR DELIVERING WATER TO VEGETAL CULTIVATIONS,
Brevetti Umbria S.r.l., Perugia (Italy). (Assignee).
L. Gubbiotti.
U.S. Patent No 4,223,837, 4 p, 4 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, p 1352, September 23, 1980.

Descriptors: *Patents, *Irrigation, *Application equipment, Irrigation practices, Irrigation efficiency, Water delivery.

The invention relates to a device to supply constantly and continuously a pre-fixed amount of water to a vegetal cultivation, so as to maintain in the cultivation an optimum amount of moisture. The purpose of the invention is to provide a device having a low cost and simple operation and capable of automatically delivering an amount of water in a continuous and controlled way. The device is provided with a reservior or tank carried by a support, a floating body mounted inside the reservoir and a syphon shaped capillary, one end of which dips into the water, passes through the floating body, while the other end is located outside in order to deliver the water. (Sinha-OEIS)
W81-05080

IRRIGATION MACHINE,
L. J. Melcher.
U.S. Patent No 4,222,520, 11 p, 12 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 911, September 16, 1980.

Descriptors: *Patents, *Irrigation systems, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation ditches, Automatic control.

A framework mounted on wheels to follow a ditch path carries siphon tubes suspended at their outer end from an arm pivotable in response to a float detecting the water level in the ditch. The inner end of the tubes contain water impeller blades mounted on a common shaft through all tube heads, retaining the heads in submerged position in the ditch. The structure supporting the outer tube ends is spring biased to raise the tubes, and each tube has a flexible mid-portion and a water trap in the outer end. A silt remover agitator is mounted on a longitudinal track and powered to move between the opposite ends of the framework to entrain silt in the water for removal by the siphon tubes. A wheel trash remover at the upstream end of the framework is self-powered by the current to catch and eject debris from the ditch water, and a dam at the downstream end of the framework retains the ditch water under the framework. A clock timer controls the movement of the framework at fixed intervals by actuating an electric drive motor that also turns the impeller shaft at the conclusions of each movement. (Sinha-OEIS)
W81-05086

AN INTERACTIVE COMPUTERIZED AID FOR THE DESIGN OF BRANCHING IRRIGATING NETWORKS.
Technion-Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
S. Pleban, and I. Amir.
Transactions of the ASAE, Vol 24, No 2, p 358-361, March-April, 1981. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Computer programs, *Irrigation design, *Network design, Capital costs, Pipes, Operating costs.

An interactive computer program, based on linear programming, aids irrigation network design by determining the optimal economical combination of two opposing factors: the cost of the investment (pipes, pumps, etc.) and operating costs (labor and energy). The program is designed for a branching irrigation network with a single source. Required input data includes: (1) pipes--number, length, Hazen Williams coefficient, and numbers of two nodes at the beginning and end of each pipe; (2) nodes--number, evaluation, and minimal pressure head for proper irrigation; (3) source--number, elevation, and curve of discharge vs. pressure head; and (4) prices--pipes, energy, interest rate, and life span of pipes. The output includes Line No., optimal diameters of pipes, length of pipe, and total annual cost. The procedure may be used to design a new network and can be modified to improve an existing network. (Cassar-FRC)
W81-05122

REDUCING FARM DELIVERY LOSSES IN PAKISTAN.
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
W. Clyma, W. D. Kemper, and M. M. Ashraf.
Transactions of the ASAE, Vol 24, No 2, p 367-374, March-April, 1981. 9 Tab, 22 Ref.

Descriptors: *Water delivery, *Irrigation canals, *Channel improvement, Irrigation efficiency, Water loss, Canals, Open channels, *Pakistan, Canal linings, Ditch linings, Field ditches, Cleaning, Maintenance, Cost-benefit analysis.

Irrigation delivery systems were studied in the Punjab Province of Pakistan. The following physical factors influencing water delivery were considered: flow rate (usually unregulated), cross sections (great variation, many too rough or too shallow), hydraulic radius (randomly selected), slope (generally very small), seepage rate (high infiltration in the silty loam, banks riddled with insect and rodent burrows), roughness, and management (poor because of lack of knowledge and technical assistance). Many alternatives were examined. Farmer clearing and maintenance and reconstruction of earthen channels is very beneficial, with benefit: cost ratios of 2.9 to 17.6. Total system improvements had the highest ratios. Brick-masonry canal lining is not economical. Soil-cement lining is not cost effective without total system improvement. Side lining required improvement of the field ditches. Land leveling is valuable when combined with side lining. (Cassar-FRC)
W81-05123

IRRIGATED CORN YIELD RESPONSE TO WATER.
Southwestern Great Plains Research Center, Bushland, TX.
J. T. Musick, and D. A. Dusek.
Transactions of the ASAE, Vol 23, No 1, p 92-98, 103, January-February, 1980. 7 Fig, 3 Tab, 18 Ref.

Descriptors: *Irrigation, *Corn, *Crop yield, Agriculture, Water demand, Irrigation effects, Irrigation efficiency, Irrigation practices, Irrigation requirements, Water requirements.

A three year study was conducted to evaluate corn yield response to water and functional relationships between yield and seasonal evapotranspiration (ET). Corn was grown after grain sorghum in 1975 and 1976 and after fallow in 1977. A 6-cm irrigation was applied to emergence in 1975 and 5.0 cm was applied in 1976 and 1977 to ensure uniform stands. The soil profile was uniformly dry in 1976, and a 15-cm preplant irrigation was applied for initial wetting. The experiment consisted of nine water management-plant stress treatments in 1975, 15 in 1976, and 14 in 1977. The seasonal climate was very different in each of the three years. Seasonal ET under treatments irrigated for high yields was 66.7 to 78.9 cm, seasonal irrigation water requirements were 40 com, grain yields were 9,250 to 10,850 kg/ha, and seasonal water-use efficiencies were 125 to 146 kg/ha-cm. Water deficits reduced average grain yields by 172 to 287 kg/ha-cm and average seasonal water-use efficiencies by 67 to 94 percent below the adequate water-high yield treatment. The threshold seasonal ET for beginning of grain yield was about one-half the seasonal ET for high yields. The relationship of ET and grain yield was compared to other studies. Due to the sensitivity of corn to plant-water stress in the climate of relatively high evaporative demand in the Southern High Plains, it was concluded that limited irrigation of corn should not be practiced. (Baker-FRC)
W81-05129

STATISTICAL ANALYSIS OF RESULTS FROM IRRIGATION EXPERIMENTS USING THE LINE-SOURCE SPRINKLER SYSTEM,
Utah Agricultural Experimental Station, Logan.
R. J. Hanks, D. V. Sisson, R. L. Hurst, and K. G. Hubbard.
Soil Science Society of America Journal, Vol 44, No 4, p 886-888, July/August, 1980. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Statistical analysis, *Crop yield, *Sprinkler irrigation, Irrigation effects, Irrigation practices, Irrigation water, Mathematical studies, Regression analysis, Wheat, Data interpretation.

The effect of several crop treatment variables and irrigation on crop yield and other characteristics was examined using the line-source irrigation system. The system permits visual observation of some irrigation effects while requiring a minimum of space. Treatment by irrigation interaction and regular treatment effects may be described validly by statistical tests when replicate treatments are used in randomized strips at right angles to the sprinkler line. Since the amount of irrigation is always applied systematically with no randomization, no statistical test exists for the effect of irrigation level on yield. It is not necessary to assign a probability level to the significance of irrigation effects because they are usually large and obvious. Caution should be exercised in interpreting small differences between adjacent irrigation levels. Bias may occur when estimating regressions of yield on irrigation levels accomplished through systematic arrangement. (Geiger-FRC)
W81-05141

DETERMINING LEACHING FRACTION FROM FIELD MEASUREMENTS OF SOIL ELECTRICAL CONDUCTIVITY,
Science and Education Administration, Riverside, CA. Salinity Lab.
J. D. Rhoades.
Agricultural Water Management, Vol 3, No 3, p 205-215, 1980/1981. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Conductivity, *Soils, *Leaching, Measuring instruments, Salinity, Saline soils, Irrigation, Mathematical equations, *Irrigation efficiency.

A simple, practical method of inventorying irrigation projects for on-farm irrigation efficiency is needed in order to help conserve water. Available water balance data are usually not suitable for such assessments and in any case do not permit evaluation of field variability. The four-electrode method has been shown to provide a relatively rapid, inexpensive means to measure soil electrical conductivity in the field. The theory of using soil electrical conductivity to determine the leaching fraction (the fraction of infiltrated water passing the root zone) is explained, and field tests validating the theory are reported. The field tests demonstrated that soil electrical conductivity can be used to determine the leaching fraction in the field, provided that the soil is at steady state, the chemical composition of the irrigation water is known, the soil water content is at or near field capacity at or below the lower extremity of its root zone depth, and the relation between soil electrical conductivity and soil water electrical conductivity is known fo the soil type of that depth and field. (Carroll-FRC)
W81-05252

TRICKLE IRRIGATION: EMITTER CLOGGING AND OTHER FLOW PROBLEMS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 8C.
W81-05253

SIMULATION OF WATER FLOW IN THE SOIL UNDER SUB-SURFACE TRICKLE IRRIGATION WITH WATER UPTAKE BY ROOTS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Inst. for Desert Research.
For primary bibliographic entry see Field 2G.
W81-05312

DISTRIBUTION OF WATER AND SALT IN SOIL UNDER TRICKLE AND POT IRRIGATION REGIMES,
Tehran Univ., Karaj (Iran), Dept. of Irrigation Engineering.
M. H. Alemi.
Agricultural Water Management, Vol 3, No 3, p 195-203, 1980/1981. 4 Tab, 17 Ref.

Descriptors: *Trickle irrigation, *Subsurface irrigation, *Soil mechanics, Water distribution, Salts, Irrigation, Soils, Solute transport, Water transport, *Pot irrigation, Comparison studies, Arid climates.

Trickling irrigation provides a relatively efficient means for irrigating crops in dry parts of the world. An understanding of the displacement of salts by water during irrigation is important for increasing the efficiency of applied fertilizers. This study investigated the distribution of water and salt in an air-dried soil from a vertical, buried elliptical pot source and the effect of redistribution time on the distribution of salt and water in the soil, and compared these findings with those obtained from a trickle irrigation source for equal amounts of water and salt and the same redistribution time in a sandy loam soil. Five hundred milliequivalents of calcium chloride were applied to the soil by each method and were later leached by applying 50 liters of tap water. Analysis of soil samples showed that pot irrigation resulted in water application at the rate of 130 milliliters per hour and movement of the salt to a radial distance of 41.5 centimeters in 390 hours. Water applied at a rate of one liter per hour by the trickle irrigation method moved the salt 42 centimeters in 52.5 hours. When equal amounts of water were applied by each system, the salt was leached further in the profile by the lower application rate of the pot. At the end of infiltration, salt and water moved to almost identical distances laterally, but the vertical distance of the wetting front was deeper for pot irrigation. After 72 hours of redistribution, the wetted volumes were about equal for the two irrigation systems. Although salt was transported more efficiently to a greater distance with relatively less chloride left in the inner part of the wetted volume by the slower application of the pot method, trickle irrigation, with the higher flow rate, was found to be more efficient for salt transport when the infiltration time was considered. (Carroll-FRC)
W81-05313

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOW ROUTING IN THE SUSQUEHANNA RIVER BASIN: PART IV--ROUTING RESERVOIR RELEASES IN THE EASTERN SUSQUEHANNA RIVER BASIN IN NEW YORK STATE,
Geological Survey, Albany, NY. Water Resources Div.
T. J. Zembrzuski, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221533, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-117, 1981. 31 p, 9 Fig, 6 Tab, 7 Ref.

Descriptors: *Flow characteristics, *Model studies, *Routing, *Reservoir releases, Regulated flow, Streamflow, Low flow, Evaluation, *Pennsylvania, *Susquehanna River basin, *New York, Waverly, East Sidney Lake, Whitney Point Lake.

Flow-routing models for six reaches of major streams in the eastern Susquehanna River basin in New York were developed and used to trace releases of water from East Sidney Lake and Whitney Point Lake to gaged points downstream. Daily streamflow during 1942-77 was modeled for the following reaches: Susquehanna River--Unadilla to Conklin, Conklin to Vestal, and Vestal to Waverly; Chenango River--Sherburne to Greene, and Greene to Chenango Forks; Tioughnioga River--Cortland to Itaska. The models were developed with convolution techniques and were based on the unit-response method of flow routing, assuming the diffusion analogy and using multilinearization. Overall accuracy of the models, as measured by the average difference between observed and simulated daily flows over the base period, was within the stated accuracy of published gaging-station records. As an example of one application of the models, hypothetical releases from East Sidney Lake and Whitney Point Lake during low flow were traced downstream to the Waverly gaging station at the lower end of the area studied. The leading edge of the East Sidney release arrived in 4 days, and the full release arrived in 6 days. The leading edge of the Whitney Point release arrived in 1 day, and the full release arrived in 3 days. (USGS)
W81-05014

AQUATIC WEED HARVESTING APPARATUS,
M. B. Brown.
U.S. Patent No 4,222,217, 9 p, 9 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 809, September 16, 1980.

Descriptors: *Patents, *Aquatic weeds, *Aquatic weed control, Equipment, Water hyacinth, Channel improvement, Hydrilla.

An aquatic weed harvesting apparatus is adapted to provide a relatively high rate of harvesting, and which is particularly adapted to minimize the level of hydrosoil disturbance during harvesting operations. The apparatus is provided with suction pumping means surrounding by an enclosing envelope to reduce the level of water turbulence as water and aquatic weeds are drawn through the envelope and into the pumping means. The pumping means comprises as a centrifugal pump including a housing having an intake port. A skimmer tray extends away from the housing and the intake port. The apparatus is mounted on either a mobile trailer, or on a floating craft so that the pump housing may be moved upward and downward to position the upper rim of the skimmer tray with only the first few inches below the surface of the water permitted to enter the intake port of the pump. This results in a high rate of intake of the water hyacinths which customarily float on the top of the water, while restricting the amount of water taken with the aquatic weed. For use in harvesting hydrilla, the envelope comprises an enclosing transition which completely surrounds the intake port and transcends to a thin slot into which the hydrilla are drawn. Cutting means are provided adjacent the slot to sever the weeds and permit the weeds to be drawn into the transition and pump. (Sinha-OEIS)
W81-05087

IMPROVED HOURLY RESERVOIR OPERATION MODEL,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 6A.
W81-05097

ROLE OF TRENCH BACKFILL IN SUBSURFACE DRAINAGE-A REVIEW.
Department of Agriculture, Columbus, OH, Soil Drainage Research Unit.
N. R. Fausey, and S. S. Hundal.
Transactions of the ASAE, Vol 23, No 5, p 1197-1200, October-November, 1980. 25 Ref.

Descriptors: *Subsurface drainage, *Drainage engineering, *Backfill, *Excavation, *Soil types, Drainage, Controlled drainage, Drainage ditches, Drains, Drainage systems, Drainage practices, Earthwords, Flow, Permeability, Permeability coefficient.

The role of trench backfill in subsurface drainage is reviewed. In comparative studies, it was found that backfilling the drain trench with permeable soil more than doubled the flow into the drain. The natural hydraulic conductivity of the soil used in backfilling, the soil moisture, weather conditions at the time of trenching, the type of machinery used for excavation, and the changes within the strench zone with time are all thought to influence the performance of the backfill. Studies of trench backfill in subsurface drainage have produced a very limited amount of information from which general conclusions can be drawn, because the conditions under which field investigations are conducted are often difficult to establish. The theoretical analyses show that permeable trench backfill increases drainflow rate and water table drawdown rate. Information comparing trench and plow-installed drains is insufficient to determine which is more efficient. (Titus-FRC)
W81-05126

THE IMPACTS OF CATCHMENT AFFORESTATION ON WATER SUPPLY INTERESTS,
North West Water Authority, Warrington (England).
P. D. Walsh.
Aqua, No 4, p 82-85, April, 1980. 28 Ref.

Descriptors: *Reforestation, *Forest management, *Water supply, Catchment basins, Lakes, Reservoir operation, Water storage, Interception loss, Evapotranspiration, Earth dams, Dams, Runoff, Water loss, Trees, Rainfall, Erosion control, Water pollution control, Fertilizers, Pesticides, Safety, Water quality, *Forest hydrology, Watershed management.

Afforestation in reservoir catchments conflicts with water supply management. Studies have shown that trees prevent some precipitation from reaching a reservoir through evapotranspiration and interception loss--on the order of 13-21% for a catchment which is 75% afforested. Some management practices to minimize unfavorable impact on water supplies are: (1) minimize plowing for planting forest trees, (2) use semi-contour techniques to produce a steady, controlled runoff and drainage, avoiding standing water in ditches, (3) select a tree species with desirable water requirements and interception capacities, (4) direct a thinning regime (early, regular, and heavy) toward minimizing water loss and erosion, (5) leave stumps to stabilize soil, (6) regulate use of fertilizers and pesticides, and (7) eliminate trees immediately adjacent to earth dams and overflow structures. With proper forest management, timber production and water resources may be compatible. (Cassar-FRC)
W81-05248

4B. Groundwater Management

WATER RESOURCES OF THE TERRACE AQUIFERS, CENTRAL LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05011

HYDROGEOLOGY OF THE BUFFALO AQUIFER, CLAY AND WILKIN COUNTIES, WEST-CENTRAL MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
R. J. Wolf.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-215519, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-4, 1981. 83 p, 39 Fig, 6 Tab, 37 Ref.

Descriptors: *Geohydrology, *Aquifers, *Groundwater availability, Wells, Water yield, Hydraulic conductivity, Infiltration, Model studies, Water properties, Model studies, Groundwater movement, Recharge, Surface-groundwater relations, Water quality, *Minnesota, Clay County, Wilkins County, Buffalo River.

The Buffalo aquifer is the principal source of ground-water supplies in the Moorhead, Minnesota area. The aquifer is an elongate deposit of sand and gravel, which locally contains water under confined conditions. Although the Buffalo aquifer contains about 270 billion gallons of water in storage, only 120 billion gallons could be withdrawn. Largest well yields occur along the deep trough in the center of the aquifer. Induced streambed infiltration may be possible in certain areas where the stream overlies the aquifer and where the intervening lake sediments are thin or absent. A numerical model constructed for aquifer evaluation has shown that a considerable amount of ground water is discharged through the confining bed to the stream or leaves the area as underflow to the west. Water from the Buffalo aquifer generally is very hard and of the calcium bicarbonate type. The average discharge of the Buffalo River for the base period 1946-78 ranges from 0.229 cubic foot per second per square mile near Hawley to 0.108 cubic foot per second per square mile at Sabin. Surface water in the Buffalo River drainage system is

dominantly a calcium bicarbonate type similar to ground water of the area, especially at low flow in the upper reaches of the tributaries. (USGS)
W81-05013

SAFE YIELD IN A COASTAL GROUNDWATER REGIME,
Hanover Univ. (Germany, F.R.). Inst. of Water Resources, Hydrology and Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W81-05234

ON SUBSURFACE DRAINAGE OF TRANSIENT RECHARGE,
National Geophysical Research Inst. Hyderabad (India).
R. N. Singh, and S. N. Rai.
Journal of Hydrology, Vol 48, No 3/4, p 303-311, November, 1980. 4 Fig, 16 Ref.

Descriptors: *Mathematical equations, *Subsurface drainage, *Irrigation design, Hydrologic budget, Irrigation ditches, Drainage patterns, Differential equations, Mathematical studies, Recharge, Groundwater recharge.

Mathematical modeling of the water balance of irrigated lands is crucial for the design of proper ditch or tile drainage pattern. The Boussinesq parabolic differential equation usually used to approach this problem can be numerically solved for various geometries and variation laws of characteristic physical parameters of the drainage system. However, the provision of some closed form solutions of the equation increases understanding of the physical system and is helpful in providing checks on the numerical models. A closed form solution of the equation developed by Basak was limited to the case of steady recharge. This paper discusses a closed form solution of the equation for a time-varying recharge. A typical numerical example is used to illustrate the salient features of the solution. The water table profile is shown to be a function of time for the unit value of a non-dimensional recharge parameter, whereas it was time-independent in the uniform recharge case. (Carroll-FRC)
W81-05308

FACTORS AFFECTING COST OPTIMISATION OF GROUNDWATER DEVELOPMENT SCHEMES FOR RIVER REGULATION,
Department of the Environment, Reading (England). Central Water Planning Unit.
For primary bibliographic entry see Field 6B.
W81-05311

4C. Effects On Water Of Man's Non-Water Activities

QUARTERLY PROGRESS REPORT; NATIONWIDE URBAN RUNOFF PROGRAM.
Environmental Protection Agency, Washington, DC. Water Planning Div.
For primary bibliographic entry see Field 5G.
W81-05025

HYDROLOGIC IMPACTS FROM POTENTIAL COAL STRIP MINING - NORTHERN CHEYENE RESERVATION,
Northern Cheyenne Research Project, Lame Deer, MT.
W. W. Woessner, T. J. Osborne, E. L. Heffern, C. Andrews, and J. Whiteman.
Environmental Protection Agency Project Summary EPA-600/S7-81-004, March, 1981. 4 p.

Descriptors: *Strip mines, *Coal mines, *Water quality, *Groundwater, *Hydrologic aspects, Flow discharge, Leaching, Mine spoils, Water pollution sources, Salt balance, Groundwater movement, *Baseline studies, Forecasting, Environmental effects.

Meteorological, groundwater and surface water monitoring networks were established to evaluate the occurrence, quantity, movement and quality of the water resources of the Northern Cheyenne Indian Reservation in order to assess the possible impacts of coal strip mining. On the reservation there is a complete section of the Tongue River Member of the Fort Union Formation which contains 11 major coal seams. A stacked groundwater flow system exists in which extensive clinker deposits, thick coal seams, channel sandstones and unconsolidated alluvium in the major valleys store and transmit the major portion of groundwater. Hydrologic and salt balance calculations indicate that in the Tongue River during the study period, mean discharge increased by 8% and dissolved solids load increased by 6%. In that part of Rosebud Creek within the Reservation, mean discharge increased by 150% and the dissolved solids load increased by 39%. Postulated coal strip mining at three priority study sites in the Tongue River Valley, high central divide region and Rosebud Creek Valley would have impacts on local surface water and groundwater resources. Water quality degradation from the leaching of spoils would affect the quality of the major streams. A large percentage of the leachable constituents in mine spoils would be removed by the first pore volume of spoil recharge and groundwater which passes through the spoil. Mining all strippable reserves would have a major impact on the regional groundwater quality and a significant impact on the quality of the Tongue River. Water quality impacts from coal strip mining would last for hundreds of years. (Moore-SRC)
W81-05031

ENVIRONMENTAL AND ECONOMIC IMPACT OF AGRICULTURAL LAND USE CONVERSION; AN EVALUATION METHODOLOGY,
Georgia Univ., Athens.
F. C. White, J. E. Hairston, W. N. Musser, H. F. Perkins, and J. F. Reed.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-137185, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/5-80-002, January, 1980. 127 p, 9 Fig, 21 Tab, 119 Ref, 5 Append.

Descriptors: *Water pollution sources, *Agricultural runoff, *Land use, *Soil erosion, *Economic aspects, Crop production, Sediment load, Nitrogen, Phosphorus, Soil conservation, Pesticides, Fertilizers, Environmental effects, Land use conversion.

Soil Bank, marginal, and submarginal land that was formerly not in cultivation is now being used for crop production. A methodology was developed for evaluating the environmental and economic impacts of placing such land in crop production. Environmental impacts were measured by quantifying the increased environmental loadings of sediment, nitrogen and phosphorus and by estimating the potential environmental impact of pesticides. Economic consequences considered include changes in net farm income and aggregate impact on the state's economy. The methodology was applied to the state of Georgia for the period 1973-1976. During this period 74.5 thousand hectares of marginal, submarginal, and Soil Bank land in Georgia were placed in crop production. The pollutants generated annually from each hectare of this land in crop production, on the average, are estimated to be 11.9 metric tons of sediment, 8.1 kg of nitrogen loss, and 10.5 kg of phosphorus loss. Erosion appears to be a key factor that affects environmental loadings of pollutants, and the magnitude of erosion from crop production activities on marginal, submarginal, and Soil Bank land is generally higher than on land classified as suitable for cultivation. Increasing crop acreage has substantial beneficial economic impacts that must be weighed against increased environmental loadings. Net farm income increased an estimated $61 per hectare annually. (Moore-SRC)
W81-05053

STATE VARIABLE MODEL FOR URBAN RAINFALL-RUNOFF PROCESS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W81-05166

EFFECT OF SURFACE MINING ON STORM FLOW AND PEAK FLOW FROM SIX SMALL BASINS IN EASTERN KENTUCKY,
Georgia Univ., Athens. School of Forest Resources.
B. A. Bryan, and J. D. Hewlett.
Water Resources Bulletin, Vol 17, No 2, p 290-299, April, 1981. 7 Fig, 7 Tab, 17 Ref.

Descriptors: *Flood discharge, *Mining, Flow, Storm water, Storm runoff, Small watersheds, Coal mining, Surface mining effects, Flow rates, Streamflow, *Kentucky.

The effects of surface mining were investigated on storm flow volumes and peak flow rates from six small watersheds in Breathitt County, and the findings were extended to Eastern Kentucky. The basins studied are located in the middle of the Eastern Kentucky Coal Fields extending from the Pottsville Escarpment in the west to the state boundary in the east. Hydrological records from these six watersheds were analyzed. Surface mining did not appear to change average storm flow volumes. However, average peak flows were increased by 36%. Peak flow increases were noted only during the summer. Smaller peak flows were doubled after surface mining. Moderate flows were increased by about one third. Peak flows around 100 csm (cu ft/sec/sq mi) were largely unaffected. Larger peak flows may have been reduced by surface mining. Slight reductions were suspected in the maximum annual storm flows, usually occurring in winter or spring. No time trend was noted in either storm flows or peak flows in five years of postmining record keeping. Surface mining is not concluded to present a serious floodwater discharge problem. (Baker-FRC)
W81-05167

ANALYZING URBANIZATION IMPACTS OF PENNSYLVANIA FLOOD PEAKS.
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. F. Kibler, D. C. Froelich, and G. Aron.
Water Resources Bulletin, Vol 17, No 2, p 270-274, April, 1981. 3 Fig, 6 Tab, 11 Ref.

Descriptors: *Flood peak, *Urbanization, Effects, Flood frequency, Flood forecasting, Forecasting, Model studies, Simulation, Watersheds, Urban drainage, Urban hydrology, Urban watersheds.

A summary is presented of data obtained to date from studies designed to analyze urban effects on flood frequency in Pennsylvania. Two approaches have been used to generate much of the data: flood peak regressions for selected urban basins where sufficiently long records are available; and rainfall-runoff simulation by distributed model using multiple discrete storms from the period of record. With regard to the statistical analysis of historical flood data for urban watersheds in Pennsylvania, it is clear that a certain nonhomogeneity has affected most of the longer term records--either through nonstationarity in the occurrence of wet and dry years or through the pattern of urbanization which has occurred progressively throughout the period of record. It is doubtful that regression techniques can provide any significant relationships for the impact of urbanization on the flood frequency curve. Limited rainfall-runoff modeling on Abers and Pickering Creek watersheds indicated that significant increases can be expected in the mean annual flood, with decreases in standard deviation and increases in skew coefficients. Use of multiple discrete storm events is a practical alternative. (Baker-FRC)
W81-05177

STREAM WATER QUALITY AS INFLUENCED BY LAND USE PATTERNS IN THE KAKIOKA BASIN, JAPAN,
Tokyo Univ. (Japan). Dept. of Botany.
T. Hirose, and N. Kuramoto.
Journal of Environmental Quality, Vol 10, No 2, p 184-188, April-June, 1981. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Agricultural watersheds, *Land use, *Stream pollution, Phosphorus, Nitrogen, Water quality, Cropland, Kakioka Basin, *Japan.

The effect of land use patterns on the inorganic ion concentration in streamwater in the agricultural area of the Kakioka Basin, Japan, was investigated. Samples were collected from 52 sites and were analyzed for ten inorganic ions: NO3-N, NH4-N, PO4-P, K, Na, Ca, Mg, Cl, and SO4-S. Land use maps were used to determine land use of the drainage areas for each site. Partial correlations indicated that streamwater quality was affected by the fraction of the drainage area in various land uses. There was no correlation between the drainage area and ion concentration for all ions except PO4-P. Concentrations of NH4-N, Na, and SO4-S were correlated with the fraction in croplands, and the concentrations of NO3-N, NO2-N, PO4-P, K, Ca, Mg, and Cl were correlated with the fraction in the settlement area. First and second canonical correlation coefficients were highly significant. The first canonical variate revealed the effect of increasing croplands and settlements with the increase in drainage area, and the second variate revealed the different effects of croplands and settlements on the streamwater quality. (Small-FRC)
W81-05322

4D. Watershed Protection

EROSION CONTROL MATTING PUT TO THE TEST.
Public Works, Vol 111, No 10, p 77-79, October, 1980.

Descriptors: *Erosion control, *Soil erosion, *Materials testing, Bank erosion, Grasses, Road construction, North Dakota, Nylon filaments.

A three-dimensional structure of entangled nylon filaments was tested for erosion control by the North Dakota Department of Transportation in the North Dakota badlands. The material is a bulky mat of very open construction, leaving 90% of its volume to be filled with soil, gravel, or other appropriate material. Upon installation, it holds grass seed in place, slows down the velocity of runoff water, and provides pockets for grass to establish itself. It is black, so it absorbs heat to promote faster seed germination. In the test situation, the grass started sooner and did better on the matting than on the unprotected shoulders. The 4000 sq yd of material cost $1.10/sq yd. In a similar test in Illinois, there was no erosion after two months even when 2 inches of rain fell over two days. New grass had started to develop and grow through the mat. After nine months, vegetation was fully developed in the matted area. The downstream area immediately adjacent to the Illinois test site has some erosion. In this case, the mat cost about $4.50/sq ft. (Small-FRC)
W81-05184

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

IDENTIFICATION OF NATURAL AND ANTHROPOGENIC CONTRIBUTIONS TO HEAVY METAL ENRICHMENTS IN GREAT LAKES SEDIMENTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
R. M. Owen, and J. E. Mackin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246290, Price codes: A02 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, East Lansing, Technical Completion Report, June, 1981. 23 p, 2 Fig, 3 Tab, 39 Ref. OWRT-A-110-MICH(2).

Descriptors: *Trace metals, *Rare earth elements, Pollutants, Diagenesis, *Sediments, Little Traverse Bay, Lake Michigan, Michigan, Comparison studies.

Surficial sediment samples were collected at 47 stations in Little Traverse Bay, Lake Michigan, to determine the geochemical associations between certain rare earth elements (REE's) and trace metals. Each sample was analyzed for carbonate carbon, organic carbon, grain size and the elements Al, Ca, Ce, Co, Cr, Eu, Re, Hf, La, and Mn. Two distinct Ce subpopulations were identified by graphical analysis, and an R-mode factor analysis was applied to data from the 'enriched' Ce subpopulation (18 samples). Results show that the REE's and trace metals are primarily enriched in the authigenic phase of these sediments. Partial correlation analyses indicate that the REE's are primarily associated with hydrous Fe oxides relative to organic matter in this phase. The ratio of Ce/La concentrations increased markedly from the bay margins to the central trough of the bay, indicating that Ce, similar to Fe, exhibits a variable oxidation state in the authigenic phase of nearshore fine-grained sediments. The authors' results suggest that the REE's and trace metals behave coherently in the authigenic phase of recent lacustrine sediments, and the REE's may be useful as geochemical tracers to differentiate between trace metal enrichments in surface sediments due to diagenesis and pollution loadings. (See also W81-05006)
W81-05005

AUTHIGENIC ASSOCIATIONS BETWEEN SELECTED RARE EARTH ELEMENTS AND TRACE METALS IN LACUSTRINE SEDIMENTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
R. M. Owen, and J. E. Mackin.
Environmental Geology, Vol 3, p 131-137, 1980. 2 Fig, 3 Tab, 39 Ref. OWRT-A-110-MICH(1).

Descriptors: *Trace metals, *Rare earth elements, Pollutants, Diagenesis, *Sediments, Comparison studies, Little Traverse Bay, Lake Michigan.

Surficial sediment samples were collected at 47 stations in Little Traverse Bay, Lake Michigan, to determine the geochemical associations between certain rare earth elements (REE's) and trace metals. Each sample was analyzed for carbonate carbon, organic carbon, grain size, and the elements Al, Ca, Ce, Co, Cr, Eu, Fe, Hf, La, and Mn. Two distinct Ce subpopulations were identified by graphical analysis, and an R-mode factor analysis was applied to data from the 'enriched' Ce subpopulation (18 samples). Results show that the REE's and trace metals are primarily enriched in the authigenic phase of these sediments. Partial correlation analyses indicate that the REE's are primarily associated with hydrous Fe oxides relative to organic matter in this phase. The ratio of Ce/La concentrations increased markedly from the bay margins to the central trough of the bay, indicating that Ce, similar to Fe, exhibits a variable oxidation state in the authigenic phase of nearshore fine-grained sediments. The results of the present study suggest that the REE's and trace metals behave coherently in the authigenic phase of recent lacustrine sediments, and the REE's may be useful as geochemical tracers to differentiate between trace metal enrichments in surface sediments as a result of diagenesis and pollution loadings. (See also W81-05005)
W81-05006

EVALUATION OF SOLID SORBENTS FOR WATER SAMPLING,
Little (Arthur D.), Inc., Cambridge, MA.
J. C. Harris, M. J. Cohen, Z. A. Grosser, and M. J. Hayes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106585, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-80-193, March, 1981. 4 p, 1 Fig, 3 Tab, 1 Ref.

Descriptors: *Water sampling, *Organic compounds, *Resins, *Adsorbents, Water pollution, Phenols, Pyrrole, Pollutant identification.

The chromatographic approach to characterization of sorbent/solute behavior allows rapid, simple quantitative evaluation of resins for water sampling applications. The volumetric breakthrough capacity has been shown to be a fundamental property of the sorbent/solute system. Volumetric breakthrough values determined in small scale laboratory experiments were valuable in setting design parameters for full-scale sampling cartridges. Uptake is greatly affected by the flow rate through the cartridge. A combination of two dissimilar resins is the most promising approach to a general purpose sorbent sampling system based on the results of screening a variety of sorbent/solute pairs. In particular, the XAD-2/XE-347 system was found to be comparable with solvent extraction in regards to recovery of model compounds. Low molecular weight and polar organic species such as phenol and pyrrole were recovered in higher yield from the cartridge than by solvent extraction. The mixed bed XAD-2/XE-347 sorbent cartridge is recommended for use for general and for compound-specific sampling of organics from water at levels of 10-100 ppm and below. (Moore-SRC)
W81-05030

A COMPUTER-CONTROLLED MULTICHANNEL CONTINUOUS FLOW ANALYSIS SYSTEM APPLIED TO THE MEASUREMENT OF NITRATE, CHLORIDE AND AMMONIUM IONS IN SMALL SAMPLES OF RAIN WATER,
Netherlands Energy Research Foundation ECN, Petten.
J. Slanina, F. Bakker, A. Bruyn-Hes, and J. J. Mols.
Analytica Chimica Acta, Vol 113, No 2, p 331-342, January 15, 1980. 11 Fig, 5 Tab, 4 Ref.

Descriptors: *Spectrophotometry, *Water analysis, *Computers, Photometry, Calibrations, Performance evaluation, *Rain, Nitrate, Chloride, Ammonium, Ions, *Rain water.

A multichannel continous flow system based on spectrophotometric determinations was developed for water analysis. Under computer control, each determination is calibrated automatically, the calibration is checked, and standards are measured frequently, followed by recalibration when necessary. The system should be able to accommodate many flow methods with transient peaks, but its application to nitrate, chloride, and ammonium ions is discussed. Samples are injected into a water stream, which is then mixed with appropriate reagents by merging flows. This technique improves background signals. Nitrate, chloride, and ammonium ions were determined in small samples (less than 0.5 ml) of rainwater in the range of 0.2-20 ppm. Normally, the accuracy of the method was better than 3%. The calibration procedure is generally complete in 1 to 1.5 hr, so 100 to 180 samples can be processed each day. The system can analyze accurately a long series of samples. (Small-FRC)
W81-05143

CONCENTRATION OF TRACE METALS FROM NATURAL WATERS BY FREEZE-DRYING PRIOR TO FLAME ATOMIC ABSORPTION SPECTROMETRY,
Aveiro Univ. (Portugal). Dept. of Chemistry.
A. Hall, and M. C. Godinho.
Analytica Chimica Acta, Vol 113, No 2, p 369-373, January 15, 1980. 1 Tab, 15 Ref.

Descriptors: *Freeze drying, *Trace metals, *Atomic absorption spectroscopy, Iron, Aluminum, Nickel, Manganese, Chromium, Copper, Cadmium, water analysis.

The potential of freeze-drying for the concentration of trace metals in river water prior to flame atomic absorption spectrometry was investigated by comparing the recoveries of known concentrations of Al, Cd, Cr(VI), Cu, Fe, Mn, and Ni by freeze-drying with those obtained by solvent extraction and chelating ion-exchange techniques. The average precision for extraction was 7% and for freeze-drying was 6%. Extraction gave virtually complete recoveries of Cd, Cu, Mn, and Pb but recoveries of about 75% for Fe and Cr(VI). For

freeze-drying recoveries were nearly 100% for Fe, Mn, and Ni, higher than 100% for Al, Cr, and Cu, and about 90% for Cd. The high recoveries of Al, Cu, and Cr were associated with very low concentrations present in the samples. There were low cadmium recoveries no matter what concentration technique was used. Thus, freeze-drying was as effective as solvent extraction or chelating ion exchange for Fe, Mn, Al, Ni, Cr, Cu, and Cd. (Small-FRC)
W81-05144

SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF FORMIC ACID AND FORMALDEHYDE IN EFFLUENT WATERS WITH OR WITHOUT PRECONCENTRATION,
Phelps Dodge Corp. Morenci, AZ. Extractive Metallurgy Research Lab.
D. E. Jordan.
Analytica Chimica Acta, Vol 113, No 1, p 189-194, January, 1980. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Effluents, *Chemical analysis, Formic acid, *Formaldehyde, Spectrophotometry, Trace levels, Industrial wastes, Pollutant identification.

This communication describes rapid methods of determining formic acid and formaldehyde in waters, with or without preconcentration, by optimizing the variables described in the spot test. Preconcentration by extraction with diethyl ether readily extends the lower detection limit to 0.05 ng/liter or less, depending on sample volume. The total formic acid and formaldehyde is determined by reducing the formic acid to formaldehyde with magnesium metal and hydrochloric acid, acidifying further with sulfuric acid, and applying the chromotropic acid method. Formaldehyde is determined separately in the same way without the reduction. Thus, formic acid can be determined by difference. (Baker-FRC)
W81-05145

STRIPPING POLAROGRAPHY AND THE REDUCTION OF COPPER(II) IN SEA WATER AT THE HANGING MERCURY DROP ELECTRODE,
Naval Ocean Systems Center, San Diego, CA.
A. Zirino, and S. P. Kounaves.
Analytica Chimica Acta, Vol 113, No 1, p 79-90, January, 1980. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Sea water, *Copper, Polarographic analysis, Anodes, Electrodes, Trace metals, Metals, Trace elements, Heavy metals.

This paper presents a general treatment for reversible and irreversible systems for use in stripping polarography and examines some of the analytical implications of irreversibility. The reduction of copper in sea water is used to illustrate some points. The data examined show stripping polarography to be a useful complement to anodic stripping voltammetry because it gives information about the substance undergoing reduction as well as about the mechanism of the reduction. This information can then be applied directly to the study of electroactive species in natural media which are measurable by anodic stripping voltammetry. This work indicates that the reduction of copper(II) in sea water at the hanging mercury drop electrode at natural pH is irreversible and that this irreversibility can be lessended by acidification or by complexation with ethylenediamine. These treatments also prevent the adsorption of copper(II) on cell walls and natural particulate matter and improve the analytical sensitivity of the anodic stripping voltammetric analysis for copper. Current speciation models suggest that the overall reduction of copper(II) in sea water at pH 8 at the mercury electrode is kinetically hindered due to the fact that copper(II) at pH 8 forms a hydroxide or carbonate or hydroxycarbonate complex, or that hydrogen carbonate and carbonate in the reaction layer impede the reduction, or that both phenomena occur. (Baker-FRC)
W81-05146

A SOLVENT EXTRACTION TECHNIQUE FOR DETERMINING NANOGRAM PER LITER CONCENTRATIONS OF CADMIUM, COPPER, NICKEL AND ZINC IN SEA WATER,
Skidaway Inst. of Oceanography, Savannah, GA.
R. G. Smith, Jr., and H. L. Windom.
Analytica Chimica Acta, Vol 113, No 1, p 39-46, January, 1980. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Sea water, *Chemical analysis, Cadmium, Copper, Zinc, Nickel, Solvents, *Trace metals, Water quality management, Water quality, Spectrometers, Atomic absorption spectrophotometry, Photometry, Heavy metals.

This paper describes a dithizone-chloroform extraction technique for concentrating copper, nickel, cadmium, and zinc from natural waters and subsequently determining them by flameless atomic absorption spectrophotometry. The extraction of nickel requires the addition of dimethylglyoxime. The metals are concentrated from 100 ml of sea water into 2.0 ml of dilute nitric acid and subsequently determined by electrothermal atomic absorption spectrometry. Extraction parameters, interferences and contamination are considered. The precision, based on replicate analyses, is about 10% for each of the four metals, and the recovery is quantitative, based on spiked sample analysis. The technique is also applicable to fresh water samples. Some of the advantages of the method include the fact that only small sample sizes are required, the lengthy digestion times needed for other methods are avoided, and the large number of samples that may be handled in the course of a day speeds analytical work. About 35-50 samples can be extracted for copper by one worker in the course of one day; slightly fewer for cadmium, nickel and zinc extraction due to the added time for pH adjustment. (Baker-FRC)
W81-05147

SPECTROPHOTOMETRIC DETERMINATION OF COBALT IN SEA WATER AND BRINES BY SOLVENT EXTRACTION WITH 2,2'-DIPYRIDYL-2'-PYRIDYLHYDRAZONE,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
Th. A. Kouimtzis, C. Apostolopoulou, and I. Staphilakis.
Analytica Chimica Acta, Vol 113, No 1, p 185-188, January, 1980. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Sea water, *Cobalt, *Chemical analysis, Water analysis, Solvents, Spectrophotometry, Water quality management, Water quality, Trace elements.

A new method is described for the determination of cobalt in sodium chloride and sea water, in which cobalt is extracted with 2,2'-dipyridyl-2-pyridylhydrazone (DPPH) and the cobalt complex is back-extracted into 20% perchloric acid. Many sources of error found with other methods can be thus avoided. For 500-ml samples of sea water the relative standard deviation is 5% for 2 ppb of cobalt. For brines of 30 g sodium chloride per liter cobalt can be determined down to 5 ppb. (Baker-FRC)
W81-05148

CONTINUOUS MONITORING OF HEAVY METALS IN INDUSTRIAL WASTE WATERS,
Siemens A.G., Erlangen (Germany, F.R.). Forschungslab.
H. Cnobloch, W. Kellerman, D. Kuhl, H. Nischik, and K. Pantel.
Analytica Chimica Acta, Vol 114, p 303-310, February, 1980. 8 Fig, 6 Ref.

Descriptors: *Chemical analysis, *Heavy metals, Silver, Mercury, Lead, Copper, Cobalt, Iron, Cadmium, Zinc, Nickel, *Industrial wastewater, Wastewater, Municipal sewage, Colorimetry.

A method is described which should provide a simpler approach to the continuous detection of heavy metals in sewage and waters. The apparatus developed serves mainly as a monitor which sets off an alarm when the given limiting value is exceeded. The operators of sewage plants or galvanic shops should then be able to take countermeasures immediately so as to prevent major pollution episodes. The method by which the instrument functions is based on coulometric principle following concentration by preelectrolysis. The following metals can be detected: silver, mercury, lead, copper, cobalt, iron, cadmium, zinc, and nickel. The use of an automatic laboratory model of the heavy metal ion detector for eight months at the inlet of a municipal sewage plant and for nine months at the outlet of a neutralization plant of a galvanic shop are described. The sampling must be thoroughly checked every two to four weeks. The preparation of samples in monitoring galvanic waste waters is without problems, and requires little maintenance. During operation of the detector, the oxidation of the deposited heavy metals must take place in a clean and defined electrolyte solution. If oxidizable substances are present in this solution, their conversion will lead to response signals which simulate those of heavy metals. (Baker-FRC)
W81-05149

PRECONCENTRATION AND SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM(VI) IN NATURAL WATERS BY COPRECIPITATION WITH BARIUM SULFATE,
Kinki Univ., Osaka (Japan). Dept. of Chemistry.
H. Yamazaki.
Analytica Chimica Acta, Vol 113, No 1, p 131-137, January, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Water analysis, *Chromium, *Chemical analysis, Spectrophotometry, Trace elements, Heavy metals.

A selective and accurate procedure is described for the preconcentration of chromium (VI), in which chromate ion is selectively coprecipitated with barium sulfate prior to spectrophotometric determination. The method is based on the fact that the solubility product of barium sulfate is similar to that of barium chromate; it is suitable for the determination of chromium(VI) in natural waters. Three river water samples were collected and the chromium(VI) contents determined by this procedure. Chromium(VI) could be quantitatively recovered, when known amounts were added to the samples. The results were in good agreement with those obtained by the aluminum hydroxide coprecipitation method. The relative standard deviation for the determination of chromium(VI) in river water was estimated to be less than 5.1%. The method uses salicylic acid as a masking agent for iron, aluminum and chromium. The precipitate (with barium sulfate) is fused with alkali carbonate, and the chromium(VI) in the melt is isolated with hot water and determined spectrophotometrically with diphenyl carbazide. The detection limit is 0.02 micro g/liter. (Baker-FRC)
W81-05150

IDENTIFICATION AND DETERMINATION OF TRACE ORGANIC SUBSTANCES IN TAP WATER BY COMPUTERIZED GAS CHROMATOGRAPHY-MASS SPECTROMETRY AND MASS FRAGMENTOGRAPHY,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
R. Shinohara, A. Kido, S. Eto, T. Hori, and M. Koga.
Water Research, Vol 15, No 5, p 535-542, May, 1981. 8 Fig, 4 Tab, 8 Ref.

Descriptors: *Trace levels, *Organic compounds, *Water analysis, *Pollutant identification, Gas chromatography, Mass spectrometry, Chemical analysis, Ion exchange resins, Hydrocarbons, Odor, Taste, Pesticides, Detergents, Tap water, Water supply systems.

A large number of trace organic substances were detected at concentrations of one to 240 parts per billion in tap water using a combination of analytical methods: Amberlite XAD-2 resin adsorption, computerized gas chromatography-mass spectrometry, high resolution mass spectrometry, and mass fragmentography. Highly polar compounds were analyzed by chemical ionization and field desorption mass spectrometry. Compounds identified included: xylenes; trimethyl, propyl, diethyl, dimeth-

ylethyl, diisopropyl, and alkyl (C 11 to 14) benzenes; propyl toluene, methyl and C13 alkyl lindane; methyl and dimethyl tetrahydronaphthalene; naphthalene; biphenyl; dimethyl naphthalene; methyl, acetyl, and alkyl biphenyls; dibenzofuran, fluorene, benzene hexachloride; methyl fluorene, phenanthrene or antracene; methyl phenanthrene or methyl anthracene; terphenyls; 2-ethoxy-1-propanol; benzaldehyde; methyl benzoate, methanol, benzo-, aceto-, dimethyl-, and butyrophene; ethyl benzaldehyde; alcohols; dimethyl, diethyl, dibutyl, and di(2-ethylhexyl) phthalate; 1-phenyl propane-1,2-diol; tributyl phosphate; propyl anisole; 9-fluorenone; anthraquinone; and di(2-ethylhexyl) adipate. High molecular weight compounds (400-600) included polyethylene glycol esters used as nonionic detergents. (Cassar-FRC)
W81-05153

DETECTION OF TOXIC SUBSTANCES IN WATER BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, and O. W. Prozesky.
Water Research, Vol 15, No 5, p 553-559, May, 1981. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Toxicity, *Cultures, *Wastewater analysis, *Pollutant identification, Effluents, Toxins, Heavy metals, Metals, Copper, Cadmium, Lead, Mercury, Ammonia, Phenol, Water analysis, Microscopic analysis.

The cloning efficiency of mammalian cell cultures (HeLa, mouse lymphoma, and Buffalo green monkey cells) was used to detect known toxicants in water. The cell culture system was twice as sensitive as an electronic fish bioassay system. HeLa was the least sensitive of the three cell lines; Buffalo green monkey cells, the most sensitive. Percentage survivals at the lowest concentrations (all in micrograms per liter) of toxicants were: Cu, 0.025 micrograms per liter concentration, 69.8-93.4%; Cd, 0.065, 30.4-73.5%; ammonia, 0.5, 78.8-74.4%; phenol, 0.5, 67.6-74.4%; Hg, 0.005, 42.1-87.4%; and Pb, 0.5, 51.0-66.8%. Settled sewage effluent was much more toxic (0.7-19.1% survival) to Buffalo green monkey and mouse lymphoma cells than biofilter humus tank effluent and activated sludge effluent (31.4-67.15%). (Cassar-FRC)
W81-05162

BIOLOGICALLY EFFECTIVE DOSE TRANSMITTED BY CULTURE BOTTLES IN 14C PRODUCTIVITY EXPERIMENTS,
Scripps Institution of Oceanography, La Jolla, CA.
R. C. Smith, and K. S. Baker.
Limnology and Oceanography, Vol 25, No 2, p 364-366, March, 1980. 3 Fig, 8 Ref.

Descriptors: *Ultraviolet radiation, *Productivity, *Phytoplankton, *Glass, Cultures, Light penetration, Chlorophyll, Analytical techniques, Pollutant identification, Comparison studies.

The biologically effective dose of ultraviolet radiation was reduced 6% by quartz bottles, 13% by Pyrex bottles, and 22% by Wheaton glass bottles at the surface of the water in C14 productivity experiments. Sets of curves were developed, one for clear ocean waters (0.02 mg chlorophyll per cu meter) and one for more productive waters (0.5 mg chlorophyll per cu meter) where the biological dose vs. depth may be determined for each type of culture bottle. At increasing depths the differences between bottle materials were less. (Cassar-FRC)
W81-05199

DETECTION OF ROTAVIRUS IN SEWAGE,
Kiel Univ. (Germany, F.R.). Dept. of Medical Microbiology.
J. Steinmann.
Applied and Environmental Microbiology, Vol 41, No 4, p 1043-1045, April, 1981. 1 Tab, 16 Ref.

Descriptors: *Pollutant identification, *Enteroviruses, Viruses, Separation techniques, Isolation, *Human diseases, Domestic wastes, Filtration, Chemical precipitation, Electron microscopy, Adsorption, Assay.

Rotavirus has been shown to be an important cause of viral gastroenteritis in infants. Methods for the concentration and detection of rotavirus from domestic sewage are described. Viruses were concentrated from 24 different samples of domestic sewage of Kiel, West Germany by adsorption to and elution from positively charged Seitz filters followed by centrifugation or by chemical precipitation. Viral concentrates were examined by an enzyme-linked immunosorbent assay and electron microscopy. Rotavirus was detected in 25% of the samples by the combined filtration and ultracentrifugation method followed by enzyme-linked immunosorbent assay and electron microscopy. After chemical precipitation, no positive results were obtained. (Geiger-FRC)
W81-05204

SIMULTANEOUS DETERMINATION OF TRACE METALS IN SEA WATER USING DITHIOCARBAMATE PRE-CONCENTRATION AND INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY,
National Inst. for Environmental Studies, Yatabe (Japan).
C. W. McLeod, A. Otsuki, K. Okamoto, H. Haraguchi, and K. Fuwa.
Analyst, Vol 106, No 1261, p 419-428, April, 1981. 1 Fig, 7 Tab, 18 Ref.

Descriptors: *Sea water, *Trace metals, Chemical analysis, Water analysis, Pollutant identification, Spectrometry, Emission spectroscopy.

A modified dithiocarbamate extraction procedure in combination with inductively coupled plasma (ICP) emission spectrometry was evaluated for the simultaneous determination of cadmium, copper, iron, molybdenum, nickel, vanadium, and zinc in sea water. Method development considerations focused on maximizing the sea water concentration factor, minimizing the potential matrix interference effects in the sea-water concentrate, and minimizing the number of steps for sample processing. The analytical results for open-ocean samples indicate that the ICP method offers a high detection capability, together with good precision and reliability. The metals are extracted from 500 g of sea water with ammonium tetramethylenedithiocarbamate - diethylammonium diethyldithiocarbamate in chloroform and back-extracted into nitric acid; the seawater concentration factor is 250 or 500. The detection capability extends into the ng/l range. (Baker-FRC)
W81-05206

A RADIOIMMUNOASSAY TO SCREEN FOR 2,4-DICHLOROPHENOXYACETIC ACID AND 2,4,5-TRICHLOROPHENOXYACETIC ACID IN SURFACE WATER,
Alabama Univ., Birmingham. Dept. of Microbiology.
D. F. Rinder, and J. R. Fleeker.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 375-380, March, 1981. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Radioimmunoassay, *Herbicides, *Water analysis, Organic compounds, Phenolic pesticides, Pollutant identification, Staphylococcus, 2,4-Dichlorophenoxyacetic acid, 2,4,5-Trichlorophenoxyacetic acid, Radiometry.

A radioimmunoassay screening method was developed to detect the herbicides 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in surface and groundwater. Although the method did not distinguish between the two compounds, further analysis by gas chromatography would produce qualitative and quantitative information. Tests with plant metabolites and chemically similar herbicides found had low reactivity with the serum for MCPA, 2,4-DB, silvex, 2,4-dichlorophenol, 4-hydroxy-2,5-D, and 4-hydroxy-2,3-D. Therefore, these compounds would not interfere with the screening test. 2,4-D (concentrations 0.01, 0.1, 1.0, and 10.0 micrograms per liter) and 2,4,5-T (1.0 micrograms per liter) were recovered from river water at 90% or greater. This method, which precipitated the antibody with Staphylococcus cells, is faster and simpler than other methods which separate antibody from unbound labeled ligands. (Cassar-FRC)
W81-05209

A NITROGEN POWERED CONTINUOUS DELIVERY, ALL-GLASS-TEFLON PUMPING SYSTEM FOR GROUND-WATER SAMPLING FROM BELOW 10 METERS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W81-05228

DETERMINATION OF TRACE METALS IN SEA WATER BY CHELEX-100 OR SOLVENT EXTRACTION TECHNIQUES AND ATOMIC ABSORPTION SPECTROMETRY,
Superfos A/S, Vedbaek (Denmark).
L. Rasmussen.
Analytical Chimica Acta, Vol 125, p 117-130. 1981. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Trace metals, *Seawater, *Measurement techniques, Solvents, Atomic absorption spectrophotometry, Spectral analysis, Cadmium, Lead, Nickel, Copper, Zinc, Resins, Chelation, *Pollutant identification.

The use of graphite-furnace atomic absorption spectrometry (g.f.a.a.s.) or electrochemical methods for direct determination of trace metals in sea water has been attractive because of the minimal sample preparation required. However, troublesome interferences and the low concentrations of pollutants and micronutrients have led to an emphasis on preconcentration methods. This paper compares preconcentration of trace metals on a Chelex-100 chelating resin with preconcentration by complexing with a mixture of ammonium-1-pyrrolidinedithiocarbamate (APDC) and diethyl ammonium diethyldithiocarbamate (DDDC), extraction with freon-TF, and back-extraction with nitric acid into a water phase. These preconcentration techniques were tested prior to g.f.a.a.s. determinations of cadmium, lead, nickel, and copper and flame atomic absorption spectrometry determination of zinc. Comparison of these preconcentration methods showed that consistent and reliable results were obtained only for cadmium, while results for the other trace metals may be biased by reagent contamination in the Chelex-100 method. Recovery data for both preconcentration methods are presented, and filtering experiments with the Chelex-100 method are described. No significant differences were noted between samples preconcentrated immediately after sampling and those preconcentrated some weeks after sampling, using only freezing for preservation. Preconcentration by the extraction method described was found to be more reliable and robust than the Chelex-100 procedure. The results of this study are consistent with those of other recent work in this area. (Carroll-FRC)
W81-05233

AUTOMATIC MONITORING OF SURFACE WATER QUALITY, (CONTROLE ET SURVEILLANCE AUTOMATIQUES DE LA QUALITE DES EAUX DE SURFACE),
Syndicat des Communes de la Banlieue, Paris (France).
J. Cheze, and M. Dutang.
Aqua, No 7, p 25, 27-30. 1980. 4 Fig, 3 Tab.

Descriptors: *Water analysis, *Automation, *Water quality, Surface water, Organic compounds, *Pollutant identification, Monitoring, Heavy metals, Nitrogen compounds.

In designing a station for automatic monitoring of surface water quality, geographical location and objective parameters must be analyzed. The station should be located near the treatment plant for practical reasons. Samples should be prepared for analysis by filtration and mineralization under ultraviolet radiation. References samples must be free of all interfering trace elements. Three types of anlyzers are used: titration by electrodes for ammonia, nitrites, nitrates, phosphates, cyanides,

fluorides, total organic carbon, and chlorides; polarography for Cr, Mn, As, and Ni by falling mercury drops, Pb, Cu, Zn, and Cd by redissolving hanging Hg drops, and Hg by redissolving on solid electrodes; and spectrophotometers for phenols and hydrocarbons. (Cassar-FRC)
W81-05237

A PRACTICAL APPROACH TO ENSURING ACCURACY OF WATER QUALITY DATA,
Water Research Centre, Stevenage (England).
D. J. Dewey.
Aqua, No 6, p 21-22, 24-25, 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Quality control, *Water analysis, Errors, Water quality control, Pollutant identification, Precision, Laboratories, Monitoring.

A five-stage system of analytical quality control for chemical analysis in water laboratories is described. A proper method for each situation is chosen and described clearly, including calibration and calculation procedures. The method is then tested by an experienced analytical chemist and any likely sources of error noted. Precision is determined on replicates of standard solution, usually over a period of 10 days. To monitor accuracy, control charts are maintained after the method is applied to routine analyses. The same sample is analyzed by different laboratories to determine any bias or deterioration with time. Any discrepancies are investigated further. Results of testing lead and cadmium samples by seven laboratories are presented for illustration. (Cassar-FRC)
W81-05242

ASSESSMENT OF OIL CONTAMINATION IN THE MARINE ENVIRONMENT BY PATTERN RECOGNITION ANALYSIS OF PARAFFINIC HYDROCARBON CONTENT OF MUSSELS,
Washington Univ., Seattle. Lab. for Chemometrics..
P. W. Kwan, and R. C. Clark, Jr.
Analytica Chimica Acta, Vol 133, No 2, p 151-168, May 1, 1981. 4 Fig, 6 Tab, 29 Ref.

Descriptors: *Oil pollution, *Chemical composition, Seawater, Oily water, Oil spills, Oil wastes, Industrial wastes, *Mussels, Hydrocarbons, Puget Sound basin, Washington.

Mussels were collected quarterly over a period of two years at 10 sites in the greater Puget Sound basin of Washington, to provide data on existing or baseline levels of paraffinic hydrocarbons in mussels from a variety of environmental locations. One sample consisting of 6-14 individuals was collected at each site during each of the four seasons, giving a total of 80 samples for the two year study. Concentrations of 26 paraffinic hydrocarbons were determined by gas chromatography. Fundamental statistical treatment of the data did not reveal meaningful trends. Application of pattern recognition techniques to the hydrocarbon data set allowed the mussel samples to be successfully classified into groups, from areas near known sources of potential pollution or from areas remote from known pollution. Several samples could not be grouped consistently as either from contaminated or uncontaminated sites. The mussels from a particular area could be separated as to season of sampling. Seasonal variations of individual paraffinic hydrocarbons were greater than annual changes. The n-C16 hydrocarbon concentration was most useful of the 34 features studied for establishing possible oil spill contamination in test areas. (Baker-FRC)
W81-05246

PRESERVATION AND STABILITY OF INORGANIC SELENIUM COMPOUNDS AT PPB LEVELS IN WATER SAMPLES.
Canada Centre for Inland Waters, Burlington (Ontario).
V. Cheam, and H. Agemian.
Analytica Chimica Acta, Vol 113, No 2, p 237-245, January, 1980. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Water analysis, *Selenium, Hydrogen ion concentration, *Sample preservation, Sample preparation, Performance evaluation.

The stability of inorganic selenium(IV) and selenium(VI) species at levels of 1 and 10 micrograms/liter was investigated under different pH levels, type of water, and type of container. Preservation of selenium(IV) at the 1 ppb level in 500 ml pyrex or polyethylene bottles at pH 1.5 (0.2% v/v sulfuric acid) was satisfactory for deionized distilled water and unfiltered Hamilton Harbor water. Higher Ph values were unsatisfactory, but at higher pH, pyrex was a better container than plastic. A 25-gallon polyethylene barrel was effective for preserving bulk water samples at natural pH for about 4 months. In general, selenium(VI) was more stable than selenium(IV) in aqueous solutions, and recoveries were satisfactory for both glass and polyethylene bottles. The essential nature of preservation techniques applicable to interlaboratory quality control studies is emphasized. (Small-FRC)
W81-05269

AUTOMATIC DETERMINATION OF BORON (0.10-10.0 MG/L) IN RAW AND WASTE WATERS,
Forth River Purification Board, Edinburgh (Scotland).
R. A. Edwards.
Analyst, Vol 105, No 1247, p 139-146, February, 1980. 7 Fig, 6 Tab, 11 Ref.

Descriptors: *Boron, *Water analysis, Wastewater, Industrial effluents, Raw water, Pollutant identification, Autoanalyzers, Spectrophotometry.

A spectrophotometric method has been developed which employs azomethine-H, a readily prepared condensation product of H-acid (8-aminonaphth-1-ol-3,6-disulfonic acid) and salicylaldehyde in boron determinations. The reagent is very sensitive to borates, forming in aqueous medium a yellow ion-associated compound by a reversible reaction. The method has a detection limit of 0.1 ng/l, and the auto analyzer response is linear to 4.0 mg/l. A calibration graph is required above this level. Tests were made for a variety of interfering compounds, but none was noted. Interference by intense sample color can be eliminated by subtracting a sample blank. (Baker-FRC)
W81-05297

DEVELOPMENT AND CONSTRUCTION OF AN ANALYZER FOR THE DETERMINATION OF THE HYDROGEN PEROXIDE CONTENT OF NATURAL WATER USING A CHEMILUMINESCENT REACTION,
Interox Chemicals Ltd., Widnes (England). Dept. of Product Research.
F. Shaw.
Analyst, Vol 105, No 1246, p 11-17, January, 1980. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Natural waters, *Chemical analysis, *Hydrogen peroxide, Trace levels, Dialysis.

A method is presented for the determination of hydrogen peroxide in natural water. The method is based on the chemiluminescent reaction of luminol with hydrogen peroxide. It is a simple, sensitive method and free of interference when samples are dialyzed before passing into the measurement cell. The analyzer described is completely portable, able to be operated from a car. The analyzer can be used automatically by the introduction of a simple automatic valve system connected to the sample calibration tube on a continuously monitoring basis. Hydrogen peroxide concentrations as low as 0.02 mg/l can be determined. (Baker-FRC)
W81-05298

APPLICATION OF CORRELATION HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY TO THE REVERSE-PHASE SEPARATION OF TRACES OF CHLORINATED PHENOLS,
Amsterdam Univ. (Netherlands). Lab. for Analytical Chemistry.
H. C. Smit, T. T. Lub, and W. J. Vloon.
Analytica Chimica Acta, Vol 122, No 3, p 267-277, 1980. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Chemical analysis, *Chlorophenols, *Chromatography, Water analysis, Phenols, Statistical analysis, Electronic equipment, Sample preparation, Pollutant identification, *Chlorinated phenols.

The use of correlation high-performance liquid chromatography online with microprocessor control is described for the analysis of chlorinated phenols to the trace contaminant level. This method has the great advantage over straightforward chromatography in that there is a rapid decrease in the detection limit in a relatively short time. The instrument was used to obtain chromatograms of mixtures of polychlorophenols at very low concentrations. The mixtures contained pentachlorophenol (PCP) and isomers of tetra-, tri-, and di-chlorophenol. PCP pollution has been reported as a problem in environmental control through its use as a wood preservative. The chemical contaminates both soil and surface water. The retention time of PCP was kept by this method well within 1 hr at a flow rate of about 1.2 ml/min. The detection limit was about 6 ppb at 254 nm. (Baker-FRC)
W81-05299

PROCEDURE FOR RECOVERY OF ENTEROVIRUSES FORM THE JAPANESE COCKLE TAPES JAPONICA,
California Univ., Berkeley. Sanitary Engineering Research Lab.
K. M. Johnson, R. C. Cooper, and D. C. Straube.
Applied and Environmental Microbiology, Vol 41, No 4, p 932-935, April, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Separation techniques, *Enteroviruses, Viruses, Isolation, Clams, Shellfish, Human diseases, Public health, Assay.

If sportfishing is reinstated in the San Francisco Bay, the Japanese cockle Tapes japonica is the most likely shellfish to be harvested. Human enteric virus levels in the species must be evaluated before the shellfish beds are opened. A method for the concentration and recovered of enteric viruses from these clams is described. A pH 9.5 glycine-buffered saline solution gave effective elution of polivirus from clam tissue. To remove cytotoxicity from clam tissue homogenates, poliovirus desorption was combined with Cat-Floc calrification. Viruses were concentrated by mixing the glycine supernatant with a beef extract solution, decreasing the pH and suspending the resulting floc in a small amount of phosphate buffer. An average of 73% of the poliovirus added to clam homogenates at levels of 93-660 plaque-forming units/100 g was recovered by this technique. Clams exposed to raw sewage had enteric viruses at levels of 26 plaque-forming units/100 g which were identified as coxsackievirus B2. (Geiger-FRC)
W81-05303

ACINETOBACTER SSP.: DISTINCT MORPHOLOGY ON EOSIN METHYLENE BLUE AGAR AS AN AID TO IDENTIFICATION IN DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH.
D. F. Spino, and E. E. Geldreich.
Applied and Environmental Microbiology, Vol 41, No 4, p 1063-1064, April, 1981. 6 Ref.

Descriptors: *Bacterial analysis, *Pathogenic bacteria, *Potable water, Drinking water, Water quality control, Isolation, Pollutant identification, Pathogens, Separation techniques, Distribution reservoirs, Water storage, Bacteria.

An investigation by the EPA on the survival of bacteria in distribution system water during storage produced 33 isolates appearing as tiny, blue colonies on Levine eosin methylene blue agar. Characterization of the isolates by the API-20E procedure showed that all of them belonged to strains of Acinetobacter calcoaceticus. Some of the colonies were non-reactive in the API system, but

were suspected of being A. calcoaceticus on the basis of their microscopic morphology. The Standard Methods most-probable-number completed test in addition to its routine role for calculating the bacteriological quality of drinking water was recommended as an enrichment procedure for demonstrating the presence of A. calcoaceticus in routine environmental samples. (Geiger-FRC)
W81-05304

SPECTROPHOTOMETRIC DETERMINATION OF DISSOLVED TITANIUM IN SEA WATER AFTER SODIUM DIETHYLDITHIOCARBAMATE PRE-CONCENTRATION,
Institute of Nuclear Energy Research, Lung-Tan (Taiwan).
C. Y. Yang, J. S. Shih, and Y. C. Yeh.
Analyst, Vol 106, No 1261, p 385-388, April, 1981. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Titanium, *Water analysis, *Sea water, Chemical analysis, Spectrophotometry.

The determination of dissolved titanium in sea water was accomplished using sodium diethylditihocarbamate as precipitant. Titanium, iron (III), zinc and part of the magnesium and calcium ions naturally present in sea water are coprecipitated. The precipitate is then collected through filtering via a 0.45 micron Metrical membrane filter. X-ray fluorescence spectroscopy was used to study the qualitative recovery of titanium and the coprecipitation of titanium with the other ions. Dilute hydrochloric acid was used to dissolve the precipitate, and a sensitive 4,4'-diantipyrylmethane-thiocyanate extraction method was applied. Spectrophotometric determination of titanium was then achieved. Tong Shiaw sea water was found to contain 0.11 micro mg/l of dissolved titanium, with a relative standard deviation of 5%. (Baker-FRC)
W81-05306

EFFECT OF POLLUTED PRECIPITATION ON WATER QUALITY--THE SITUATION IN NORWAY,
E. Gjessing.
Aqua, No 7, p 139-140, 1980. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Air pollution, *Acid rain, *Water quality, Surface water, Path of pollutants, Organic compounds, Sulfates, Heavy metals, Precipitation, *Norway, Nitrates, Copper, Zinc, Lead, Cadmium, Polychlorinated biphenyls, Polyaromatic hydrocarbons.

Chemical analysis of precipitation and surface water in Norway shows the direct and indirect effects of atmospheric pollution. All samples in this study were taken in areas unaffected by agriculture, forestry, or human settlement. Heavy metals and organic micropollutants have been found in addition to the long-established sulfate ion. The composition of a winter's snowfall (1972) in a southern Norway community, Langtjern, contained the following constituents (in mg per sq meter): sulfate, 870; nitrate, 561; Cu, 9.71; Zn, 16.75; Pb, 4.53; Cd, 0.70; organic C, 807; and organic matter, 1793. At Birkenes, near the southern tip of the country, 84 organic components (in nanograms per liter) were identified in rain water: alkanes, C21-C27 and C29-C33, 50-60; alkanes, C23-C28, 50-60; polyaromatic hydrocarbons, benzofluoranthene, 50-300 and benzopyrene, 50-300; fatty acid ethyl esters, C13, 50-150, C15, 50-200, and C17, 50-500; polychlorinated biphenyls, 2-5; and organic chlorine, 219. In 'unpolluted' lakes and brooks 10-27 ng per liter polychlorinated biphenyls and 148-247 ng per liter polyaromatic hydrocarbons were found. (Cassar-FRC)
W81-05343

5B. Sources Of Pollution

IDENTIFICATION OF NATURAL AND ANTHROPOGENIC CONTRIBUTIONS TO HEAVY METAL ENRICHMENTS IN GREAT LAKES SEDIMENTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5A.
W81-05005

AUTHIGENIC ASSOCIATIONS BETWEEN SELECTED RARE EARTH ELEMENTS AND TRACE METALS IN LACUSTRINE SEDIMENTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5A.
W81-05006

***FRESH AND SALINE GROUND-WATER MAP* OF WEST VIRGINIA,**
Illinois State Geological Survey, Urbana. Water *Resources Div.*
For primary bibliographic entry see Field 7C.
W81-05021

HYDROLOGIC IMPACTS FROM POTENTIAL COAL STRIP MINING - NORTHERN *CHEYENE RESERVATION*,
Northern Cheyenne Research Project, Lame Deer, MT.
For primary bibliographic entry see Field 4C.
W81-05031

***LEACHING OF RADIOACTIVE ISOTOPES* FROM WASTE SOLIDS,**
Office of Radiation Programs, Washington, DC.
D. S. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-162943, Price codes: A03 in paper copy, A01 in microfiche. Report EPA-520/8-81-001, January, 1981. 36 p, 19 Ref, 2 Append.

Descriptors: *Radioisotopes, *Leaching, *Radioactive waste disposal, *Mathematical models, Solid wastes, Storage, Diffusion, *Groundwater pollution, Water pollution sources.

It is essential that reliable estimates are available of the amount of radioactivity that enters the environment as a result of the treatment, storage, transport, and disposal of radioactive waste. The most commonly used empirical model for the quantity of a radioactive isotope leached from a solidified waste as a function of time is known to be inaccurate for glassy solids which devitrify. Since devitrification will occur during the long-term storage of radioactive waste isolated in glass, a new equation is needed. A theoretical model involving a generalized, non-Fickian mechanism for diffusion was developed to calculate the amount of isotope leached. The new model is based on stable isotopes, but can be adapted for unstable isotopes. When both formulas of the model are normalized to a common value, at some instant the new formula predicts larger initial quantities and faster initial leach rates. (Brambley-SRC)
W81-05033

ENVIRONMENTAL EFFECTS OF COAL TECHNOLOGIES: RESEARCH NEEDS.
MITRE Corp., McLean, VA. (METREK Div.).
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-220824, Price codes: A11 in paper copy, A01 in microfiche. A Report to the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies, June, 1981. 237 p, 7 Fig, 10 Tab, 68 Ref. DEAC-01-79-EV10018.

Descriptors: *Environmental effects, *Research priorities, *Coal mining, *Mine wastes, Coal gasification, Air pollution, Water pollution sources, Mine drainage, Storage, Heavy metals, Organic compounds, Ions, Sediments, Waste disposal, Ecosystems, Acid rain, Public health.

This report addresses major environmental problems associated with conventional coal mining, storage, transportation, and combustion, and with chemical coal cleaning, in situ gasification, fluidized bed combustion, co-combustion of coal-oil mixtures and co-combustion of coal with municipal solid waste. It was prepared by three working groups who addressed the subjects of air quality, water quality, and ecological effects. The water quality group report considered only gaps in current research and new thrusts and direction that future research should be taking. The research needs required to characterize the sources of pollution from coal mine drainage, coal storage, cleaning, combustion, transportation, in situ coal gasification, and airborne deposition are identified, followed by those concerned with the transformation and fate of heavy metals, organic compounds, major ions, and sediments. The ecological effects groups identified three overriding concerns - combustion emissions and their disposition; disposition of disturbed lands; disposal of coal ash, flue gas desulfurization sludges, and other residues - and four ecological research themes - identification of biological impacts and their intensity; comprehension of ecosystem dynamics; integrated assessment via calibrated watershed studies; and understanding of environmental toxicology. The air quality group identified research needs related to carbon dioxide build-up, chemical or acid deposition, human health effects, and degradation of visibility. (Brambley-SRC)
W81-05040

HUMAN ENTERIC VIRUS SURVIVAL IN SOIL FOLLOWING IRRIGATION WITH SEWAGE PLANT EFFLUENTS,
Texas Univ. at San Antonio. Center for Applied Research and Technology.
For primary bibliographic entry see Field 3C.
W81-05044

LONG-TERM EFFECTS OF LAND APPLICATION OF DOMESTIC WASTEWATER: CAMARILLO, CALIFORNIA, IRRIGATION SITE,
Stone (Ralph) and Co., Inc., Los Angeles, CA.
For primary bibliographic entry see Field 3C.
W81-05045

HYDROLOGIC SIMULATION ON SOLID WASTE DISPOSAL SITES (HSSWDS),
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. F. Perrier, and A. C. Gibson.
Environmental Protection Agency Report SW-868, September, 1980. 122 p, 9 Fig, 3 Tab, 19 Ref, 4 Append.

Descriptors: *Solid waste disposal, *Landfills, *Runoff, *Leachates, Computer models, *Model studies, Percolation, Land disposal, Groundwater pollution, Rainfall, Soil water, Evapotranspiration.

Percolation and runoff are of particular concern on solid waste disposal sites as a potential for contamination of ground and surface waters by leachate. The HSSWDS (Hydrologic Simulation on Solid Waste Disposal Sites) model permits rapid evaluation of design, final soil cover materials, and operational methodologies by estimating leachate generation on solid waste management systems, using an interactive computer program. A large number of stations (cities) within the United States, for which 5 years of climatic records exist, have been put on tape for easy access and can be used in lieu of on-site measurements. In addition, to expedite model usage, the model stores many default values of parameter estimates which can be used when measured and existing data files are not available. The user must supply the geographic location, site area and hydrologic length, the characteristics of the final soil and vegatative cover and default overrides where deemed necessary. From minimal input data, the model will simulate daily, monthly, and annual runoff, deep percolation, temperature, soil-water, and evapotranspiration. The model, which is a modification of the SCS curve number runoff method and the hydrologic portion of the USDA-SEA hydrologic model (CREAMS), has been modified to conform to the design characteristics of solid and hazardous waste disposal sites. The model takes hydrologic parameter input data and operates sequentially as precipitation information is read. (Moore -SRC)
W81-05061

DRAFT DEVELOPMENT DOCUMENT FOR THE ELECTRICAL AND ELECTRONIC COMPONENTS POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/075a, October, 1980. 765 p, 143 Fig, 218 Tab, 34 Ref, 1 Append.

Descriptors: *Electronic equipment, *Electrical equipment, *Industrial wastes, *Water pollution sources, Water use, Pollutants, Wastewater treatment, Water pollution control, Waste disposal, Process water, Cost-benefit analysis.

This draft document contains descriptions of the industry subcategories, their wastes, pollutants and applicable treatment technologies. A number of electrical and electronic components require no manfacturing process water, and are grouped together as a subcategory. It includes: switchgear and fuses, resistance heater, ferrite electronic parts, motor and generators, fuel cells, alternators, and insulated wire and cable, non-ferrous. The remainder of the industry is subcategorized into the following wastewater generating subcategories: carbon and graphite products, dielectric materials, electric lamp, electron tube, semiconductor, and capacitor. Each subcategory is analyzed in terms of products, size of the industry, manufacturing processes, materials, water usage, production normalizing parameters, waste characterization and treatment-in-place, potential pollutant parameters, applicable treatment technologies, and benefit analysis. Control and treatment technologies which can be implemented throughout the industry are avoidance of unnecessary dilution, reduction of flow to pollution generating processes, treatment under proper conditions, and timely and proper disposal of wastes. Specific treatments are also given, with their cost estimates. (Brambley-SRC)
W81-05063

DEVELOPMENT DOCUMENT FOR THE COIL COATING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-81/071-b, January, 1981. 497 p, 62 Fig, 146 Tab, 83 Ref.

Descriptors: *Metal-finishing wastes, *Coatings, *Industrial wastes, *Wastewater treatment, *Water pollution souces, Wash water, Effluents, Water quality standards, Heavy metals, Cyanide, Suspended solids, Hydrogen ion concentration, Costs.

For the purpose of establishing effluent limitations for existing sources, standards of performance for new sources, and pretreatment standards, the EPA has divided the coil coating category into three categories based on basis material, steel, galvanized or aluminum. Wastewater results from rinsing the coil surface and the volume is proportional to the surface area cleaned and coated, so the production normalizing parameter is the area cleaned or coated. The limitations and standards are based on sampling and analysis of wastewater streams. BPT limitations are given for heavy metals, cyanide, oil and grease, total suspended solids, and pH for the three categories and standards for new sources and pretreatment standards for new and existing sources are proposed. Proposed limitations based on BCT are given for oil and grease, total suspended solids and pH. The costs of BPT and BAT treatment are within the capability of the coil coating industry and are reasonable considering the environmental benefits attained. (Brambley-SRC)
W81-05064

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE COAL MINING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-229296. Price Codes: A19 in paper copy, A01 in microfiche. Report EPA-440/1-81/057-b, January, 1981. 451 p, 71 Fig, 76 Tab, 94 Ref.

Descriptors: *Coal mines, *Mine wastes, *Effluents, *Water pollution control, *Regulations, Heavy metals, Toxicity, Strip mines, Underground mines, Sedimentation basins, Sediment control, Hydrogen ion concentration, Storms, Pollutants, Wastewater pollution, Wastewater treatment.

This study was conducted to determine the presence and concentrations of the 129 toxic or 'priority' pollutants in the coal mining point source category for possible regulation, assess them for establishing effluent limitations to regulate post-mining discharges, assess the appropriateness of establishing a separate subcategory for regulation of discharges from coal mines in the western United States, and review and augment existing effluent limitations during rainfall and snowmelt conditions. Of the toxic pollutants, the only ones found at levels which can be controlled were eight metals. These are already effectively controlled by BPT technology, so no further controls are necessary. Limitations on post-mining discharges from surface mines will be established to reduce pH and settleable solids. This can be achieved by the use of sedimentation ponds. For underground mines the technology used for treatment of raw drainage during mining will be used after mine closure. Settleable solids and pH will be limited during rainfall events smaller than those by a 10-year, 24-hour storm; for greater events only a pH limitation will apply. A separate 'western mines' subcategory was not considered necessary. For acid drainage mines, alkaline drainage mines, and existing preparation plants and associated areas the BAT effluent limitations will be the same as the BPT effluent limitations. New preparation plants will be subject to a zero discharge of wastewater pollutants. (Brambley-SRC)
W81-05065

ACID GROUNDWATER,
Swedish Water and Air Pollution Research Lab., Goeteborg.
H. Hultberg, and S. Johansson.
Nordic Hydrology, Vol 12, No 1, p 51-64, 1981. 7 Fig, 16 Ref.

Descriptors: *Acidic water, *Aluminum, *Groundwater pollution, Lakes, Water pollution sources, Oxidation, Sulfuric acid, Air pollution effects, *Sweden.

A summary report is presented of a research project on the causes and occurrence of acid groundwater with elevated concentrations of metals in Sweden. The groundwater flow and quality were investigated around lakes Bredvatten and Lysevatten. Here, the increased concentration of aluminum found in the water was caused by acid groundwater, resulting in leaching of aluminum. The increased aluminum concentration has caused widespread ecosystem changes in these areas. Several regional investigations in southern Sweden found an even more pronounced soil and groundwater acidification which occurred via oxidation of accumulated sulfur to sulfuric acid. Thus, several soil minerals were released to the groundwater and wells, and groundwater systems were contaminated. Several thousand households have health problems related to elevated metal concentrations or have experienced pipe corrosion and economic loss. Airborne acid pollutants have severely affected the lime-poor natural ecosystem. (Small-FRC)
W81-05106

WINTER-SPREAD MANURE NITROGEN LOSS.
Cornell Univ., Ithaca, NY. Dept. of Agricultural Engineering.
T. S. Steenhuis, G. D. Bubenzer, J. C. Converse, and M. F. Walter.
Transactions of the ASAE, Vol 24, No 2, p 436-441, 449, March-April, 1981. 11 Fig, 6 Tab, 22 Ref.

Descriptors: *Manure, *Agricultural runoff, *Nitrogen compounds, Nutrients, Path of pollutants, Water pollution sources, Farm wastes, Seasonal variation, Surface runoff, Snowmelt, Frozen ground, Infiltration, Phosphorus compounds.

Laboratory and field studies show that most nitrogen lost from manure spread on frozen soils in winter is water soluble. The first melt water contains the highest concentrations of readily soluble N. If this melt water infiltrates into the soil, little N is lost. If, on the other hand, the water runs off, losses will be high. The highest losses occur when manure is spread on frozen soil covered with an ice layer or on melting snow. If infiltration is limited, up to 90% of the original area and 75% of the water soluble organic nitrogen may be lost. This amounts to 50% of the original N in the manure. Under certain circumstances, winter manure spreading can cause significant nonpoint source water pollution. (Cassar-FRC)
W81-05124

MODELLING PARATHION CHANGES IN THE NATURAL ENVIRONMENT LABORATORY EXPERIMENT (MODELISATION DE L'EVOLUTION DU PARATHION DANS LE MILIEU NATUREL SUR UN PILOTE DE LABORATOIRE),
Rennes Ecole Nationale Superieure de Chimie (France).
A. La Planche, M. Bouvet, F. Venien, G. Martin, and A. Chabrolles.
Water Research, Vol 15, No 5, p 599-607, May, 1981. 5 Fig, 4 Tab, 36 Ref.

Descriptors: *Parathion, *Bacteria, *Biodegradation, Insecticides, Pesticides, Degradation products, Degradation, Rivers, *Fate of pollutants, Toxicity, Sediments, Organophosphorus pesticides.

The degradation of parathion in a natural river environment was studied in a laboratory pilot plant for 55 days. The feed stream contained 13 mg per liter of parathion during the first 34 days, after which effluent was continuously recycled for 21 days. Biological degradation into nontoxic aminoparathion and adsorption onto the sediments were the major mechanisms of removal. The quantity of parathion removed was proportional to the quantity of ATP present. In media containing 1, 2, or 3 mg per liter suspended solids and 5, 10, or 15 mg per liter parathion, bacterial populations were not affected and aminoparathion formation occurred. A large dose, one gram per liter, destroyed the biomass. Although anionic or cationic surfactant did not alter the toxicity of parathion (at a level of 15 mg per liter) to the bacteria, degradation was totally inhibited. (Cassar-FRC)
W81-05163

AIRPORT WASTES AND WATER QUALITY,
Dade County Aviation Dept., Miami, FL.
E. Sierra, A. N. Shahane, and J. T. Villate.
Water Resources Bulletin, Vol 17, No 2, p 190-196, April, 1981. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Wastewater, *Airports, Industrial wastes, Urbanization, Transportion, *Water pollution sources, Water pollution prevention, Miami International Airport.

An attempt is made to report the characteristics of wastewaters which are produced from various operations taking place at Miami International Airport. These operations which produce wastewater include: aircraft maintenance, aircraft operations, fuel storage areas, airport terminal building facilities, and auxiliary facilities. These wastewaters contain acids or alkalies, oxygen demanding materials, detergents, phosphates, suspended solids, dissolved solids, oil and grease, organic solvents, phenols, cyanides, heavy metals, and bacteria. Considering these characteristics, it appears that servicing, maintenance, overhauling, and washing of aircraft are the most significant industrial wastewater producing activities. Phenols could be of concern if stripping and repainting activities occur. The aircraft rebuilding and overhauling facilities contribute the largest volume of wastewater at the airport. It is noted that, while most airport wastes are treatable, a great reduction in influent load can be achieved by proper housekeeping methods. (Baker-FRC)
W81-05165

NITRATE IN RURAL WELLS OF THE SENEGAL RIVER BASIN.

Agency for International Development, Washington, DC.
M. S. Gould, and M. J. Healey.
Water Resources Bulletin, Vol 17, No 2, p 244-247, April, 1981. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Well water, *Nitrates, Senegal River, *West Africa, Rural areas, Contamination, Semiarid lands, Semiarid climates, Shallow wells.

The objective of this paper is to consider the possible relationships between the occurrence of nitrate in shallow wells, the physical characteristics of each well, and the sanitary conditions of the surrounding areas, as concerns the Senegal River Basin. The Senegal River is the second longest river in West Africa. The Basin is located in the Sahelian climatological region. The rain season extends from June through October, with almost no precipitation and therefore very little infiltration and runoff outside of this period. Hand dug wells are generally dug in soils of alluvial or aeolian origin. These soils are mainly sand, with minor amounts of clay and gravel. Nitrate concentrations in 34 such wells were determined over a 6-month period. With the exception of two wells, the study indicated varying levels of nitrate contamination. The range of concentrations was from 0.10 to 880 mg/1 as nitrate. Thse data did not appear to correlate strongly with physical characteristics, land use or age using a chi-square analysis. It is felt that the open nature of the wells in the semiarid climate may be of significant importance. Contamination may be primarily a result of foreign matter entering the mouth of the wells. (Baker-FRC)
W81-05174

PREDICTION OF MARINE ATMOSPHERIC DEPOSITION RATES USING TOTAL BE7 DEPOSITION VELOCITIES,
Battelle Pacific Northwest Lab., Sequim, WA. Marine Research Lab.
E. A. Crecelius.
Atmospheric Environment, Vol 15, No 4, p 579-582, 1981. 2 Tab, 20 Ref.

Descriptors: *Air pollution, *Beryllium, *Deposition rates, Atmospheric physics, Metals, Path of pollutants, Atlantic Ocean, North Sea.

Be7 was chosen as a tracer in atmospheric deposition studies because it should have the same deposition velocity as anthropogenic pollutants. In addition, its total deposition velocity is easy to measure. The atmospheric particulates collected over a one-year period at a rural site on the Washington coast were analyzed for 13 stable elements (K, Ca, Br, Ti, Cr, Mn, Fe, V, Pb, As, Se, Cu, Zn) and Be7. The ratios of the elements to Be7 in the air and total deposition rates were then used to predict total deposition velocities of the same elements in other areas: Sequim, Washington; Southern California; Ensenada, Mexico; North Sea; and Tropical Atlantic Ocean. Rates differed from site to site. Comparisons of measured deposition rates with rates calculated in 2 ways are presented. Most rates were predicted within a factor of 5. Best agreement was in values for the Tropical Atlantic. (Cassar-FRC)
W81-05203

SENSITIVE AND ACCURATE METHODOLOGY FOR MEASURING THE KINETICS OF CONCENTRATION-DEPENDENT HYDROCARBON METABOLISM RATES IN SEAWATER BY MICROBIAL COMMUNITIES,
Alaska Univ., Fairbanks. Inst. of Marine Science.
D. K. Button, D. M. Schell, and B. R. Robertson.
Applied and Environmental Microbiology, Vol 41, No 4, p 936-941, April, 1981. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Kinetics, *Metabolism, *Hydrocarbons, Fate of pollutants, *Radioactive tracers, *Seawater, Organic wastes, Natural waters, Chlorinated hydrocarbons, Organic compounds, Carbon dioxide, Separation techniques.

A method was developed for resolving the kinetic constants for dissolved non-polar substrate metabolism in natural waters. The procedure, which is based on the rate of radioactively-labeled carbon dioxide recovery from dissolved substrate, utilizes large volumes of seawater and high-specific-activity isotopes. Commercial isotopes are purified before use by mild alkaline hydrolysis and sublimation from base to remove labeled carbon dioxide and interfering polar radioactive carbon substrates. Chilled Tenax resin is employed during analysis to remove volatile radioactive carbon-labeled substrates from the nitrogen stream containing radioactive carbon recovered from substrate oxidation. Purity is checked by kinetic data from toluene utilization by mixed cultures and by rates in induced versus noninduced pure cultures. Low hydrocarbon levels and short incubation times increase accuracy, so that the metabolic rates in unamended natural waters may be calculated. In seawater, rates of toluene metabolism as low as 1 picogram/liter/hour at levels as low as 20 nanograms/liter have been measured. (Geiger-FRC)
W81-05205

EFFECT OF FLUORIDE ON COPPER, MANGANESE, AND ZINC IN BONE AND KIDNEY,
Panjab Univ., Chandigarh (India). Dept. of Biophysics.
For primary bibliographic entry see Field 5C.
W81-05207

BIOACCUMULATION OF HEXACHLOROBENZENE IN KILLIFISH (FUNDULUS SIMILIS),
Texas A and M Univ., College Station. Dept. of Chemistry.
C. S. Giam, H. E. Murray, L. E. Ray, and S. Kira.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 891-897, 1980. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Bioaccumulation, *Killifish, *Chlorinated hydrocarbons, Pesticides, Insecticides, Fish, Hexachlorobenzene, Marine animals, Fate of pollutants, Path of pollutants, Salt marshes.

Killifish (Fundulus similis) exposed to 0.04 to 0.45 micrograms per liter of hexachlorobenzene (HCB) in seawater had a calculated bioaccumulation factor of 375, which was reached after about 24 hours. Approximately 4.8 hours was required to reach half this value. In another experiment fish were not fed during acclimation; the maximum bioaccumulation factor was 420, and time required to reach half this value, 5.8 hours. These figures were considerably less than values reported for several freshwater species (up to 21,900 for green sunfish). When fish exposed to HCB for 11 days were placed in non-contaminated water, tissue concentrations of pesticide decreased exponentially with a half-life of 9-12 hours to within control levels after 48 hours. during depuration, tissue concentrations HCB (in nanograms per liter) were as follows: start, 56; 6 hours, 33; 12 hours, 23; 24 hours, 9; 48 hours, 3; and 7 days, about 1. (Cassar-FRC)
W81-05210

SELENIUM BIOMETHYLATION PRODUCTS FROM SOIL AND SEWAGE SLUDGE,
Maryland Univ., College Park. Dept. of Chemistry.
D. C. Reamer, and W. H. Zoller.
Science, Vol 208, No 4433, p 500-502, May, 1980. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Selenium, *Methylation, *Sludge, *Soil, Microorganisms, Metabolism, Detoxification.

Studies were made to determine the quantity and the volatile forms of selenium that could be released to the atmosphere from soil and sewage sludge by methylation when selenium in different oxidation states is added to under aerobic and anaerobic conditions. One purpose of these studies was to determine the effect of the oxidation state of the added selenium on the production rate of metabolites. The production of each selenium species with respect to added selenite was studied to determine the interrelationships of the metabolites. The results demonstrate that the biological methylation of selenium occurs rapidly in soil and sewage sludge and has the potential to occur in the environment if selenium is present in a soluble state. In the absence of added selenium, the sewage sludge did not evolve volatile selenium species, probably because of the low solubility of the selenium or the lack of available selenium. Microbial methylation of selenium is apparently a widespread occurrence in various media and under different conditions. Thus, biomethylation could be a pathway for the mobilization of selenium to the atmosphere. (Baker-FRC)
W81-05220

RELEASE AND CYCLING OF NUTRIENTS BETWEEN PLANKTONIC ALGAE AND HERBIVORES,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
J. T. Lehman.
Limnology and Oceanography, Vol 25, No 4, p 620-632, July, 1980. 7 Fig, 4 Tab, 45 Ref.

Descriptors: *Algae, *Nutrients, *Zooplankton, *Cycling nutrients, Path of pollutants, Chlamydomonas, Daphnia, Absorption, Mineralization, Growth rates, Nitrogen compounds, Phosphates.

Uptake and regeneration of nutrients were measured simultaneously in an intact alga-herbivore assembly, Chlamydomonas reinhardtii and Daphnia pulex. This method overcomes the problems of separating the animals from their food or severely concentrating the zooplankton before measuring nutrient release. Responses by algae to changes in nutrients and zooplankton were observed, nutrient-deficient cells acting differently from nutrient-sufficient cells with respect to the three nutrients (phosphate, dissolved phosphorus, and ammonia). The nutrient-deficient cells had greater maximal rates of nutrient uptake and resulted in lower remineralization fluxes per unit volume consumed. The tight cycling among nutrients, algae, and zooplankton markedly enhanced production rates for the algae. (Cassar-FRC)
W81-05222

INVESTIGATION OF ORGANIC CONTAMINATION OF GROUNDWATER IN SOUTH BRUNSWICK TOWNSHIP, NEW JERSEY,
Stauffer Chemical Co., Westport, CT.
P. H. Roux, and W. F. Althoff.
Groundwater, Vol 18, No 5, p 464-471, September-October, 1980. 4 Fig, 2 Ref.

Descriptors: *Organic compounds, *Contamination, *Plumes, Well testing, Path of pollutants, Trichloroethane, Tetrachloroethylene, Water pollution, Groundwater, Aquifers, South Brunswick Township, *New Jersey, Pollution abatement, Chlorinated hydrocarbons.

After organohalides (up to 1,000 ppb 1,1,1-trichloroethane and 100 to 300 ppb tetrachloroethylene) were discovered in a South Brunswick Township, New Jersey, public well (No 11) in December 1977, investigation began to locate the source(s), extent, and movement of the contamination. This was accomplished by analysis of groundwater samples from over 100 wells and by water table elevations measured in about 60 wells. The study area is underlain by two aquifers separated by clay. The upper aquifer, Old Bridge, is tapped by domestic wells, many of which are also contaminated. The lower aquifer, Farrington, is pumped by large-capacity industrial and public supply wells. Both aquifers are contaminated with organic chemicals, the water flowing from the upper to the lower aquifer through at least two holes or windows in the clay layer between them. Three plants were identified as major sources of the chemicals. Plumes of contamination were determined for each. It is predicted that another public well, No. 12, will be contaminated within a few years unless an abatement system is effective. This system is currently withdrawing and treating contaminated water. Well No. 11 is being pumped to waste and the water discharged into a sanitary sewer. (Cassar-FRC)
W81-05232

NITROGEN TRANSFORMATIONS IN STREAMS,
Wisconsin Univ.-Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W81-05256

LEACHING AND WATER-TYPE EFFECTS ON GROUNDWATER QUALITY,
Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W81-05260

COMPARATIVE UPTAKE OF URANIUM, THORIUM, AND PLUTONIUM BY BIOTA INHABITING A CONTAMINATED TENNESSEE FLOODPLAIN.
Oak Ridge National Lab., TN.
C. T. Garten, Jr., E. A. Bondietti, and R. L. Walker.
Journal of Environmental Quality, Vol 10, No 2, p 207-210, April-June, 1981. 2 Fig, 1 Tab, 27 Ref.

Descriptors: *Bioaccumulation, *Uranium, *Thorium, *Plutonium* Flood plains, *Radioactive wastes, Forages, Mammals, Insects, White Oak Creek. *Tennessee.

An investigation compared the uptake of U238, TH232, and Pu239 by biota living on a contaminated floodplain in East Tennessee. The White Oak Creek floodplain was once the site of a liquid radioactive waste retention pond. Comparisons of actinide uptake from soil by fescue, grasshoppers, and small mammals were based on analysis of radionuclide ratios in soils and biota. U:Pu ratios in small mammal carcasses such as shrews, mice, and rats, and bone samples from larger animals including rabbit, woodchuck, and opossum, were significantly greater than U:Pu ratios in the soil. There was no significant difference between Th:Pu ratios in animals and soil. The pattern of the accumulation of these actinides from soil was U Th, which later was about to equal to Pu. This pattern of extractability of actinides from soil was probably related to their valence state in the environment. Results indicate that environmentally dispersed Pu will not physiologically accumulate in terrestrial biota to any extent exceeding the accumulation of natural U. (Small-FRC)
W81-05266

THE SORPTION OF SOLUBLE PHOSPHORUS BY SOIL MATERIAL DURING TRANSPORT IN RUNOFF FROM CROPPED AND GRASSED WATERSHEDS.
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
A. N. Sharpley, R. G. Menzel, S. J. Smith, E. D. Rhoades, and A. E. Olness.
Journal of Environmental Quality, Vol 10, No 2, p 211-215, 1981. 4 Fig, 3 Tab, 26 Ref.

Descriptors: *Phosphorus, *Runoff, *Suspended sediments, Agricultural watersheds, Agricultural runoff, Fertilizers, Sediment transport, Sedimentology, Sorption, Southern plains.

The relationship between soluble phosphorus and suspended sediment concentrations in runoff and the sorption of P by soil material was investigated in several Southern plains cropped and grassed watersheds. Field and simulated laboratory conditions were used to study the adsorption of P by surface soil and suspended sediment at four cropped and seven grassed watersheds. The soluble P concentration of surface runoff decreased with an increase in sediment concentration. A linear inverse relationship between soluble P and sediment concentration was significant over a wide range of sediment concentrations. Four different watersheds with the same main soil type, the slope values of the relationship were similar. In simulations of surface runoff, sorption of soluble P added in rainfall occurred during transport. The amount of sorption was related to the sorptive capacity of the sediment in the surface runoff. Thus, for unfertilized watersheds and for watersheds where fertilizer P is incorporated into the surface soil, the leaching of P from the vegetative cover can contribute significant amounts of P to runoff. Soil material may act as a source of P rather than a sink. (Small-FRC)
W81-05272

FERTILIZER FLUX INTO TWO FLORIDA LAKES VIA SEEPAGE.
Florida Univ., Gainesville. Dept. of Environmental Engineering and Science.
C. R. Fellows, and P. L. Brezonik.
Journal of Environmental Quality, Vol 10, No 2, p 174-177, April-June, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Seepage, *Lakes, *Fertilizers, Nitrogen, Agricultural watersheds, Nitrates, Rainfall, Irrigation effects, *Florida.

During an investigation of seepage into Florida lakes, the flux of fertilizer nitrogen was monitored from a citrus grove to adjacent lakes. Of three sites in Lake Conway, only one indicated export of fertilizer nitrogen from the watershed, while three sites on Lake Apopka had no significant export of fertilizer. At the Lake Conway site, high fluxes of nitrate plus nitrate-N occurred following heavy fertilization of a citrus grove near the shore. The highest concentration was 45 mg/liter of N, measured 7.5 m from shore. The pattern of appearance of oxidized nitrogen in the lake was consistent with flow net theory. Fertilizer nitrogen first appeared near shore, and gradually seeped into the lakes as rainfall, irrigation, and diffusion processes moved the nitrate deeper into the groundwater table. Thus, proper fertilizer practices did not seem to greatly impact the two lakes. Excessive fertilization of a near-lake grove did allow 204 kg N to seep into Lake Conway over a 229-day period. (Small-FRC)
W81-05276

RADIOACTIVE SPRINGS IN THE WATERSHED OF A PROPOSED RESERVOIR IN SEQUOYAH COUNTY, OKLAHOMA: ORIGIN AND ENVIRONMENTAL EFFECT,
Oklahoma University, Norman; and Geological Survey, Norman, OK.
S. Bloch, and R. L. Craig.
Geology, Vol 9, No 5, p 195-199, May, 1981. 3 Fig, 4 Tab, 21 Ref.

Descriptors: *Radioactive springs, *Reservoirs, *Watersheds, Springs, *Oklahoma, Sequoyah County, Radium radioisotopes, Environmental effects, Water pollution sources, *Preimpoundment, *Baseline studies.

Radioactive springs occurring within about 1,800 meters of a proposed reservoir in Sequoyah County, Oklahoma, were perceived to present a potential danger to future users of the water from the reservoir. A chemical and isotopic study was conducted to assess the effect on water quality of the two radioactive mineral springs discharging into the watershed of a feeder creek and to establish the source of the brines. The study results indicated that the impact of the springs on the proposed reservoir would be negligible as a result of the extremely low rate of discharge of the springs even following periods of heavy rainfall, the effective dilution of the spring water by the creek into which the springs discharge (dilution factor of about 1:100), and precipitation of radiobarite just below the mouths of the springs. The radium rich springs contain daughter products belonging to both the uranium 238 and thorium 232 decay chains, suggesting that these radionuclides are not a surface manifestation of buried sedimentary uranium deposits. Geological factors preclude the existence of vein-type uranium-thorium deposits. Rock-to-fluid transfer of alpha-decaying nuclei in the uranium 238 and thorium 232 series is the most likely cause of the high radium content in the springs. (Carroll-FRC)
W81-05281

CONDENSED PHOSPHATES IN POLLUTED URBAN RIVER WATER,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
N. Ogura, and H. Uehara.
Japanese Journal of Limnology, Vol 41, No 4, p 203-211, October, 1980. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Phosphates, *Phosphorus compounds, *Rivers, *Detergents, *Domestic wastes, Water pollution sources, Path of pollutants, *Nogawa River, *Japan, Diurnal, Sewage.

The behavior of condensed phosphates was studied in sewage-polluted urban waters of the Nogawa River, Tokyo. Concentrations of the condensed phosphates in commercial synthetic detergents used in Tokyo were generally over 90% of the total phosphorus content of each detergent. A calculated 0.5 g per person of condensed phosphate phosphorus enters the water daily from synthetic detergents, compared with about 2 g total P per day per person from all sources. Analysis of water samples collected every 3 hours revealed condensed phosphate levels of 0.4-17.4 microgram-atom P per liter on weekdays and 0.23.9 microgram-atom P per liter on Sundays. The maximum concentration was found at noon, and the minimum at 6 am. The percentage of condensed phosphate compared to total phosphate decreased over about a 15 km distance, from 51% at the headwaters to 27% where the Nogawa River entered the Tamagawa River, indicating the hydrolysis to reactive posphate occurred along the course of the river (Cassar-FRC)
W81-05283

BIOAVAILABILITY OF MERCURY IN SEVERAL NORTH-EASTERN U.S. SPARTINA ECOSYSTEMS,
Woods Hole Oceanographic Institution, MA.
R. J. Breteler, I. Valiela, and J. M. Teal.
Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 155-166, 1981. 4 Fig, 4 Tab, 43 Ref.

Descriptors: *Mercury, *Salt marshes, *Ecological effects, Sediments, Coastal marshes, *Massachusetts, Heavy metals, Marsh plants, Crabs, Mussels, Biochemistry, Sludge, Wastewater treatment, Bioaccumulation.

Although considerable research has been done on the release of mercury from the sediments of salt marsh environments and on factors contributing to the mercury concentration of organisms, little attention has been given to the effect of the sediment itself on the availability of soil-bound mercury to biota. This paper reports data on mercury concentrations in plants and organisms from salt marsh environments experimentally treated with mercury and from marshes where heavy industrial pollution provided mercury for long periods. The effects of the organic content, soil texture, pH, and reduction-oxidation potential of the sediment on the availability of mercury to marsh plants, crabs, and mussels was evaluated. No mercury concentration increases in mussels, fiddler crabs, or marsh cord grasses were noted in plots covered with the marsh grass Spartina alterniflora which had been treated with mercury-containing sewage sludge. A considerable accumulation of mercury was found in the Spartina root system when the salt marshes were subject to very high antropogenic mercury applications, although this mercury concentration was not translocated to the rhizomes or above-ground tissues. The highest concentrations of mercury were found in animals living in the least organic marsh sediments. Although the tissue mercury contents of mussels and fiddler crabs were clearly dependent on those of the marsh sediments under mostly sandy conditions, higher levels of sediment mercury were unavailable for bioaccumulation in peaty marshes. (Carroll-FRC)
W81-05286

AMERICIUM-241 AND PLUTONIUM-237 TURNOVER IN MUSSELS (MYTILUS GALLOPROVINCIALIS) LIVING IN FIELD ENCLOSURES,
International Lab. of Marine Radioactivity, Monte Carlo (Monaco).
J. C. Guary, and S. W. Fowler.

Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 193-203, 1981. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Radioactive wastes, *Radioisotopes, *Mussels, Plutonium, Americium, Bioaccumulation, *Mediterranean Sea, Biochemistry.

The usefulness of an organism as a biological indicator which will accurately reflect spatial and temporal changes in ambient radionuclide levels is highly dependent on the retention time of the contaminants in its tissues. A series of radiotracer experiments were conducted in order to determine the biological half-lives for plutonium-237 and americium-241 in mussels living under field conditions in the Mediterranean Sea. The loss of these radionuclides from contaminated mussels was described as the sum of three exponential functions. Two short-lived compartments representing about 80 percent of the incorporated americium-241 turned over rapidly, with biological half-lives of 2 and 3 weeks. The remaining fraction of the americium-241 was associated with a long-lived compartment and was lost at an extremely slow rate. Plutonium-237 turnover in the two short-lived compartments containing 70 percent of this radionuclide was 1 to 2 days and 2 weeks. However, subsequent loss rates of the two radionuclides in the long-lived compartments may be similar if determined over comparable periods of time. Whole shell contained about 90 percent of both the americium-241 and plutonium-237 taken up by the mussels. These radionuclides readily leach from the shell into the water. These observations indicate that mollusk shell may influence the biogeochemistry of transuranic elements in intertidal zones. (Carroll-FRC)
W81-05288

IRRADIATED DIGESTED SEWAGE SLUDGE: EFFECTS ON PLANT-SYMBIONT ASSOCIATIONS IN THE FIELD,
Massachusetts Univ., Amherst. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5E.
W81-05293

METHOD FOR ESTIMATING SPILLED OIL QUANTITY ON THE SHORELINE,
South Carolina Univ., Columbia. Coastal Research Div.
K. Finkelstein, and E. R. Gundlach.
Environmental Science and Technology, Vol 15, No 5, p 545-549, May, 1981. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Oil spills, *Coasts, *Estimating, Path of pollutants, Crude oil, Oil pollution, Oil tankers, Sampling, Salt marshes.

A method for estimating the quantity of oil reaching a shoreline after an oil spill was developed during the Amoco Cadiz oil spill investigations. Aerial photographs, sediment sampling, and measurements of oil depth, width, and length of oiled beaches indicated that 62,000 metric tons of oil reached the Brittany shoreline by April 2, 1978, and that 9,200 metric tons remained on April 30, 1978. Total oil spilled from the tanker was 233,000 metric tons. Each oiled environment was treated separately: surface oil, buried oil, oiled rocks, and oiled marshland. An average oil volume per km was determined and extrapolated to the entire coastline length. Oil in heavily oiled marshes and tidal flats was separately calculated and added to the total. Possible sources of error in this method are (1) extrapolation of oil volumes from one beach to the entire coastline, (2) lack of separate measurements in rocky areas, (3) repetitive counting of oil which migrated to another area in time to be recounted, and (4) short term changes within hours or days, caused by tides, winds, and waves. (Cassar-FRC)
W81-05296

UPTAKE OF THE HERBICIDE PENDIMETHALIN BY THE SEA NETTLE CHRYSAORA QUINQUECIRRHA,
Maryland Univ. Baltimore. Div. of Dermatology.
G. J. Calton, and J. W. Burnett.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 386-388, March, 1981. 4 Ref.

Descriptors: *Sea nettles, *Pesticides, *Absorption, Pendimethalin, Herbicides, Coelenterates, Fate of pollutants, Water pollution effects, Chesapeake Bay.

Sea netles, Chrysaora quinquecirrha, a pest in recreational areas of Chesapeake Bay, actively incorporated the pesticide pendimethalin into body tissue when immersed for 16 hours in a 10 ppm solution. Uptake began within 1 hour and increased steadily. At 16 hours exposure the mesentery tentacle had incorporated the largest amount, 6.4 ppm. the fishing tentacle contained 3.5 pm, and the bell, 1.1 ppm. No behavioral changes were noted at the concentration of pendimethalin tested, which is lethal to white perch. (Cassar-FRC)
W81-05301

ACCESSION AND ORIGIN OF CERTAIN IONS FOUND IN RAINWATER OVER THE INDIAN DESERT,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Soil-Water-Plant Relationship.
For primary bibliographic entry see Field 2B.
W81-05325

EFFECT OF POLLUTED PRECIPITATION ON WATER QUALITY--THE SITUATION IN NORWAY,
For primary bibliographic entry see Field 5A.
W81-05343

5C. Effects Of Pollution

ENVIRONMENTAL EFFECTS OF COAL TECHNOLOGIES: RESEARCH NEEDS.
MITRE Corp., McLean, VA. (METREK Div.).
For primary bibliographic entry see Field 5B.
W81-05040

HEALTH EFFECTS DUE TO THE CESSATION OF CHLORINATION OF WASTEWATER TREATMENT PLANT EFFLUENTS.
Illinois Univ. at the Medical Center, Chicago. School of Public Health.
J. A. Holden.
Illinois Institute of Natural Resources, Chicago, Document No 81/14, March, 1981. 106 p, 2 Fig, 14 Tab, 161 Ref, 2 Append.

Descriptors: *Water quality standards, *Human diseases, Human pathology, *Chlorination, *Wastewater treatment, *Effluent, Administrative regulations, Social costs, Contamination, Pollutants, Bioindicators, Coliforms, Bacteria, Swimming.

There is on-going controversy over the toxic effects of chlorinating wastewater effluents, including the effect on the aquatic environment, versus the benefits, such as to human health. This review of the ways effluents containing chlorine may affect health encompasses the uses of effluent or effluent-contaminated water for drinking water, recreation, irrigaton, livestock drinking water, food processing, and commercial fishing. The ability of indicator coliforms to transfer to other bacteria factors carrying resistance to antibodies as well as factors enhancing pathogenicity is discussed. The conclusions are that: (1) wastewater treatment plant effluents contain many pathogenic organisms, of which the types, numbers, and visibilty vary depending on many factors; (2) R-plus organisms are present in sewage and wastewater treatment plant effluents; (3) wastewater treatment processes, excluding disinfection, reduce the numbers of pathogenic organisms from those found in raw sewage; (4) chlorination of effluents can reduce the numbers of pathogenic organisms to levels considered adequate for the protection of health; (5) the risk of waterborne infectious disease due to direct ingestion is very low, although effluents are implicated in the transmission of these diseases; (6) wastewater effluents are implicated in foodborne infectious disease due to irrigation of food crops; (7) wastewater effluents may casue infectious disease in animals and fish which can then affect human health; and (8) it is not known what concentration of indicator organisms, or what distance from an outfall, is needed to establish the safety of swimming water. (Garrison-Omniplan)
W81-05068

UPPER LETHAL TEMPERATURE RANGE OF LAHONTAN CUTTHROAT TROUT IN WATERS OF DIFFERENT IONIC CONCENTRATION,
Nevada Univ. System, Reno. Bioresources Center.
S. C. Vigg, and D. L. Koch.
Transactions of the American Fisheries Society, Vol 109, No 3, p 336-339, May, 1980. 3 Tab, 17 Ref.

Descriptors: *Trout, *Water temperature, Thermal stress, Physical properties, Temperature, *Temperature effects, Resources management, Lakes, Pyramid Lake, *Nevada.

To aid resource planners considering water problems in Nevada, temperature requirements of the threatened Lahontan cuttroat trout (Salmo clarki henshawi) were examined. Attempts were made to determine a provisional upper lethal temperature range in relation to three water qualities occurring within the Truckee River-Pyramid Lake ecosystem. During September of 1977, 160 Lahontan cutthroat trout of each of two genetic strains were obtained from Pyramid Lake Indian Tribal Enterprises Dunn Hatchery. After acclimation to hatchery temperature, groups of fish were placed in water from three sources: dechlorinated Truckee River water, Dunn Hatchery well water, and Pyramid Lake water. Upper lethal temperature ranges were 18.5-20.2 degrees C in Pyramid Lake water (bicarbonate alkalinity, 1,487 mg/liter), 20.2-21.1 in Dunn Hatchery well water (357 mg/liter), and 21.8-23.9 C in Truckee River water (69 mg/liter). Within each lethal temperature range, the summit Lake strain was slighlty more resistant to heat death than the Marble Bluff strain. (Baker-FRC)
W81-05120

ACCUMULATION AND DEPURATION OF TETRAMETHYLLEAD BY RAINBOW TROUT,
Canada Centre for Inland Waters, Burlington (Ontario).
P. T. S. Wong, Y. K. Chau, O. Kramer, and G. A. Bengert.
Water Research, Vol 15, No 5, p 621-625, May, 1981. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Lead compounds, *Trout, *Accumulation, Absorption, Organolead compounds, Fate of pollutants, Fish, Toxicity, Tetramethyllead, Aquatic animals, *Water pollution effects.

Young rainbow trout (Salmo gairdneri) exposed to 3.5 micrograms per liter of tetramethyl lead for two weeks accumulated tetramethyl lead in tissues from 0.43 micrograms per gram wet weight on the first day to 1.54 (+ or - 0.65), 170 (+ or - 0.54), and 2.54 (+ or - 0.67) micrograms per liter in the second, third, and seventh day of treatment, respectively. No further increase occurred after the seventh day in the two-week experiment. Of 30 fish treated, five died within the first three days. Ten larger fish, weighing more than 20 grams, exposed to higher concentrations of tetramethyl lead (24 micrograms per liter), had a two out of 10 mortality. Tissues were analyzed separately, and highest concentrations of the lead compound were found in the lipid layer of the intestine. Exposure to 51 micrograms per liter did not increase tetramethyl lead concentrations in most fish tissues, but did increase mortality to two out of three fish over 10 days. Depuration studies showed rapid decline of tetramethyl lead levels to residual levels over the 10 day study. Half lives for elimination of the compound in intestinal fat and in skin/head were 30 and 45 hours, respectively. (Cassar-FRC)
W81-05159

POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS,

Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
M. Sheehan.
Water Resources Bulletin, Vol 17, No 2, p 275-279, April, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Asbestos, *Water pollution sources, Mining, Industrial waste, *Policy making, Risks.

Two types of risk, voluntary and involuntary, have been identified as they relate to the establishment of policy regarding waterborne asbestos. In cases of asbestos pollution affecting the public at large, it was demonstrated that conclusive evidence exists that asbestos is a carcinogen, but that no effort has been made to protect the involutarily exposed public. In the workplace, on the other hand, strict regulatory practices are in effect. Rulings were made in appeals court staying the emergency injunction issued by a district court, on the basis that the court's logic was clearly incorrect. In this case the court assumed that the discharges from a specific company were not an immediate health hazard because the level of contamination was well below the occupational level. All the evidence, however, suggests that the threshold for involuntary risk acceptability is far below the voluntary occupational levels. Forcing an involuntarily exposed public to carry the burden of future potential damages is seen as representing, in effect, a redistribution of income from the population at risk to the polluter and its customers. Such a situation encourages the firm to produce more than the socially optimum level of output and charge a price that does not reflect the true costs of production. This is clearly inefficient from a social welfare point of view. (Baker-FRC)
W81-05168

CHEMICAL CHANGES DUE TO ACID PRECIPITATION IN A LOESS-DERIVED SOIL IN CENTRAL EUROPE,
Goettingen Univ. (Germany, F.R.).
B. Ulrich, R. Mayer, and P. K. Khanna.
Soil Science, Vol 130, No 4, p 193-199, October, 1980. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Acidic waters, *Forests, *Air pollution, *Acid rain, Hydrogen ion concentration, Precipitation(Atmospheric), Soil chemistry, Trees, Vegetation, Chemical reactions, Nitrogen cycle, Aluminum, Organic matter, Europe, Germany, Water pollution effects.

A Fagus silvatica forest in the Solling highlands, Federal Republic of Germany, showed increasing Al concentrations in the soil during a study of the effect of acid precipitation on the ecosystem between 1966-1979. A noticeable change occurred in 1973. Before this, carbon and nitrogen stores in the forest floor were increasing, but afterwards, they decreased. This indicates a shift from one decomposition process to another as a response to acid precipitation. The pH has remained between 3 and 4, decreasing slightly with time. Al and Fe ion concentrations increased between 1966 and 1973 to 2 mg per liter and 3 mg per liter of equilibrium soil solution, with the buffer reaction reaching deeper into the soil. Acid precipitation has induced soil internal H(+) ion production at a rate of 2.9-5.5 kmole H(+) per hectare per year, partly from changes in N nutrition and partly from N deficiency. Proton consumption by silicate weathering is estimated at 0.2-2 kmole H(+) per hectare per year, meaning that the buffering capacity of this soil is reaching its capacity. Since this forest has reached a critical stage in less than 20 years of acid rain, further acid precipitation will produce serious results here as well as in all of Central Europe, especially the ridges and plateaus of the medium highlands. (Cassar-FRC)
W81-05189

THE RELATIVE CONTRIBUTION OF AQUATIC MACROPHYTES AND THEIR EPIPHYTES TO THE PRODUCTION OF MACROPHYTE BEDS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W81-05197

SOME RELATIONSHIPS BETWEEN STREAM BENTHOS AND SUBSTRATE HETEROGENEITY,
Scarborough Coll., Toronto (Ontario). Div. of Life Sciences.
D. D. Williams.
Limnology and Oceanography, Vol 25, No 1, p 166-172, 1980. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Benthos, *Substrates, *Heterogeneity, Aquatic life, Biomass, Invertebrates, Detritus, Organic matter, Decomposing organic matter, Running waters, Lotic environment, Comparison studies.

The response of running water benthos to substrate physical heterogeneity was investigated. Four substrate mixtures were made up by dry-sieving washed, ashed, local gravel from a gravel pit. About 20.5 kg of each substrate was placed in wire baskets. Three replicates were made of each mixture, and the baskets were nestled into a streambed. Water temperature ranged between 11.1 and 2.2 degrees C, depth between 25 and 35 cm, and current speed between 40 and 60 cm/sec. The baskets remained in place for 28 days, after which the benthos of each basket was carefully examined. No differences were noted in the total numbers and weights of colonizing animals. However, 26% of the species showed clear substrate preferences, 35% showed slight preferences, and 39% showed no preference. This last group was made up mostly of the benthic invertebrate biomass. A high quantity of detritus accumulated in each substrate, which may account for the similar densities of detritivores collected on all four substrates. (Baker-FRC)
W81-05198

EFFECT OF FLUORIDE ON COPPER, MANGANESE, AND ZINC IN BONE AND KIDNEY,
Panjab Univ., Chandigarh (India). Dept. of Biophysics.
M. Singh, and K. C. Kanwar.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 428-431, March, 1981. 1 Tab, 14 Ref.

Descriptors: *Fluorides, *Kidneys, *Bone, *Metals, Copper, Manganese, Zinc, Trace elements, Toxicity, Fluoridation, Water pollution effects, Path of pollutants, Drinking water.

To assess the effects of fluoride toxicity on the levels of trace elements, copper, manganese, and zinc in the body, rats were fed 10 ppm or 25 ppm fluoride in drinking water for 10 months. In the group receiving 25 ppm fluoride, Mn increased from 11 ppm to 15 ppm in bone and decreased in the kidney, 19 to 14 ppm. Zn decreased from 360 to 310 ppm in bone and increased from 170 to 230 ppm in the kidney. Cu decreased from 8.8 to 5.2 ppm in bone and increased from 20 to 22 ppm in the kidney. The rats fed 10 ppm showed no significant differences in trace metal distributions when compared with controls. This study confirms the observation that bone is the most severely affected organ in fluoride toxicity. (Cassar-FRC)
W81-05207

TOXICITIES OF EIGHT ORGANOCHLORINE COMPOUNDS IN SEDIMENT AND SEAWATER TO CRANGON SEPTEMSPINOSA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
D. W. McLeese, and C. D. Metcalfe.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 921-928, 1980. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Shrimp, *Organic compounds, *Toxicity, Benthic fauna, Invertebrates, Water pollution effects, Seawater, Mortality, Pesticides, Polychlorinated biphenyls, Aroclors, Endrin, Endosulfan, DDT, Dieldrin, Chlordane, Insecticides.

Toxicity of eight organochlorine compounds to the shrimp, Crangon septemspinosa, was measured in seawater and sediment. The 96-hour L50s in seawater at 20 C were as follows (in micrograms per liter): endosulfan, 0.2; endrin, 0.6; DDT, 0.4; dieldrin, 0.4; chlordane, 2.0; Aroclor 1242, 13.0; Aroclor 1254, 12.0, and HCB, >7.2. Sediments were 10-80 times less toxic than seawater. At 10 C the 96-hour LC50 were (in micrograms per liter): endosulfan, 6.9; endrin, 47; DDT, 31; dieldrin, 4.1; chlordane, 120; Aroclor 1242, >780; Aroclor 1254, >3400; and HCB, >300. LT50's at 10 and 20 C were similar. Therefore, it is permissible to compare results of tests in water at 20 C with those in sediment at 10 C. Extraction efficiencies were inversely related to the water solubilities of the compounds. Seawater extraction efficiencies were: endrin, 80%; endosulfan, 72%; DDT, 100%; dieldrin, 63%; chlordane, 53%; Aroclor 1242, 61%; Aroclor 1254, 72%; and HCB, 100%. Sediment extraction efficiencies were: endrin, 74%; endosulfan, 61%; DDT, 85; dieldrin, 78%; chlordane, 59%; Aroclor 1242, 62%; Aroclor 1254, 60%; and HCB, 52%. Data indicate that the concentration of organochlorine compounds in surficial water is the primary factor controlling the toxicity to epibenthic species. In summary, it is reasonable to consider Aroclor 1254 and 1242, HCB, and chlordane in sediments as relatively non-toxic, and dieldrin, endosulfan, endrin, and DDT in sediments as potentially hazardous to benthic and epibenthic invertebrates. (Cassar-FRC)
W81-05208

INFLUENCE OF DRILLING MUDS ON THE PRIMARY CHEMOSENSORY NEURONS IN WALKING LEGS OF THE LOBSTER, HOMARUS AMERICANUS,
Marine Biological Laboratory, Woods Hole, MA.
C. D. Derby, and J. Atema.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 3, p 268-274, March, 1981. 4 Fig, 2 Tab, 42 Ref.

Descriptors: *Drilling fluids, *Lobsters, *Sublethal effects, Crustaceans, Drilling, Water pollution effects, Marine animals, Mud.

Chemoreception is probably the dominant sensory modality with which lobsters and most other benthic organisms relate to their environment, using it to obtain food and mates. The sensory input from chemoreceptors on the walking legs of lobsters is essential in eliciting the normal sequence of feeding behaviors, including both the location and the grasping of food items. The effects of exposure to whole drilling muds on the physiology of primary sensory neurons were examined by recording neurophysiological responses from the chemoreceptors in the walking legs of lobsters. These tests resulted in reproducible drilling mud-induced changes in the responses of chemoreceptors to feeding stimuli. A 3 to 5 minute exposure to 10 or 100 milligrams per liter of whole used drilling mud altered the normal activity of 33 percent and 50 percent, respectively, of the leg chemoreceptors of all of the previously unexposed lobsters tested. In lobsters which had been exposed to the drilling mud for 4 to 8 days prior to the neurological testing, 25 percent and 37.5 percent of the chemoreceptors in the legs were inhibited by 10 and 100 milligrams per liter drilling muds, respectively. However, normally functioning receptors were found even among the lobsters treated over several days, indicating that not all chemosensory neurons on the legs are altered by such long-term drilling mud exposures. Some chemosensory neurons on the walking legs were found to respond positively to drilling mud itself. (Carroll-FRC)
W81-05213

GRAZING OF ACARTIA HUDSONICA (A. CLAUSI) ON SKELETONEMA COSTATUM IN NARRAGANSETT BAY (USA): INFLUENCE OF FOOD CONCENTRATION AND TEMPERATURE,
Rhode Island Univ., Kingston. Oceanography Graduate School.
For primary bibliographic entry see Field 2L.
W81-05224

THE EFFECTS OF A PHOTOSYNTHESIS INHIBITOR ATRAZINE, ON SALT MARSH EDAPHIC ALGAE, IN CULTURE, MICROECOSYSTEMS, AND IN THE FIELD,

Auburn Univ., AL. Dept. of Botany and Microbiology.
F. G. Plumley, and D. E. Davis.
Estuaries, Vol 3, No 4, p 271-277, December, 1980. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Salt marshes, *Diatoms, *Algae, *Atrazine, Photosynthesis, *Herbicides, Marshes, Water pollution effects, Chlorophyll, Toxicity, Aquatic algae.

Atrazine, widely used as a herbicide in corn and sorghum production, has been found in coastal ecosystems following agricultural use. The maximum safe level for the herbicide atrazine in the salt marsh was established at 10 ppb after investigations in the field, in microecosystems, and in cultures of Nitzschia sigma Grun., and Thalassiosira fluviatilis Hustedt. A concentration of 2.2 ppm (0.00001 M) atrazine reduced the rate of photosynthesis, chlorophyll content and cell numbers in cultures and in microecosystems. At 0.000001 M atrazine, chlorophyll production and cell density were maintained, but photosynthesis was reduced. In the field, atrazine effects were less severe than in microecosystems or cultures. Although diatom species diversity was not affected by the 2.2 ppm concentration of atrazine in microecosystems or in the field, the number of Cymatosira belgica Grun. was increased. (Cassar-FRC)
W81-05227

EFFECTS OF PHARMACEUTICAL WASTES ON MICROBIAL POPULATIONS IN SURFACE WATERS AT THE PUERTO RICO DUMP SITE IN THE ATLANTIC OCEAN,
Maryland Univ., College Park. Dept. of Microbiology.
E. R. Peele, F. L. Singleton, J. W. Deming, B. Cavari, and R. R. Colwell.
Applied and Environmental Microbiology, Vol 41, No 4, p 873-879, April, 1981. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Water pollution effects, *Industrial wastes, *Marine bacteria, *Ocean dumping, Wastewater disposal, Aquatic bacteria, Microorganisms, Bacillus, Staphylococcus, Vibrio, Microbiological studies, Coastal waters, Surface waters, Bacterial analysis, *Puerto Rico.

The effects of pharmaceutical wastes on the microflora of surface waters in the Atlantic Ocean off the Puerto Rican coast were studied in a series of cruises during 1979 and 1980. The waste plume from the disposal barge was monitored, as well as stations along a series of transects extending north from coastal waters through and beyond the dump site. The largest numbers of culturable bacteria occurred from near-shore samples close to the dump site. A predominance of Vibrio and Aeromonas spp. were obtained from these sample areas on marine agar. Gram-positive organisms (staphylococci, micrococci, and bacilli) were dominant in areas immediately affected by waste dumping. Total numbers of bacteria were relatively stable throughout the region, while heterotrophic bacterial activity declined with increasing distance from the land. Increased specific activity indices were observed near the dump site. (Geiger-FRC)
W81-05249

NITROGEN TRANSFORMATIONS IN STREAMS,
Wisconsin Univ.-Madison. Dept. of Civil Engineering.
J. Y. C. Huang, and D. J. Wozniak.
Journal of Environmental Sciences, Vol 24, No 2, p 41-45, March/April, 1981. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Nitrogen cycle, *Streams, *Nitrification, Nutrients, Nitrogen compounds, Nitrates, Ammonia, Oxygen, Dissolved oxygen, Sediments, Microorganisms, Water pollution effects, Fate of pollutants, Denitrification, Photosynthesis.

A review of the nitrogen cycle in streams describes the complex relationships between the forms of nitrogen as dependent on physical, chemical, and biological characteristics of a stream. Nitrification (nitrate formation from ammonia or nitrogen) can cause oxygen depletion in a stream. This process is accomplished by Nitrosomonas and Nitrobacter, autotrophic microorganisms, which are most numerous at the surface of the sediment, on particulate matters, and on rocks. Denitrification (the reduction of nitrates to nitrogen) is accomplished by heterotrophic microorganisms. Optimum conditions for denitrification are pH 7.0-7.5; temperature, 25-35 degrees C; in a highly reduced, organic-rich sediment. In the Thames River, severely polluted with wastewater effluent, nitrification did not appear until 48.3 km downstream from London Bridge, probably a result of insufficient dissolved oxygen directly downstream from the worst pollution. Following upgrading of the treatment plants, which resulted in a BOD only 25% of the earlier value, the onset of nitrification moved upstream nearly 32.2 km. (Cassar-FRC)
W81-05256

THE EFFECTS OF WATER TEMPERATURE ON THE DEVELOPMENT OF PROLIFERATIVE KIDNEY DISEASE IN RAINBOW TROUT, SALMO GAIRDNERI RICHARDSON,
Veterinary Research Lab. Belfast (Northern Ireland).
H. W. Ferguson.
Journal of Fish Diseases, Vol 4, No 2, p 175-177, March, 1981. 1 Tab, 2 Ref.

Descriptors: *Fish diseases, *Water temperature, Temperature, Animal diseases, Physical properties, Seasonal variation, Thermal pollution, Trout, *Rainbow trout.

Forty-five juvenile fish were moved to the laboratory on October 18 and kept in recirculating water at 16 C, which is an average summer water temperature. At the time of moving the fish they were infected with proliferative kidney disease (PKD). By January, 10 of 14 fish examined had developed the full clinical disease. The fish still on the farm were also being monitored and showed no evidence of PKD. Water temperatures on the farm were between 0 and 1 C. It was assumed therefore that declining water temperatures in the autumn are responsible for the failure of the disease to fully develop in fish of this age. A second group of fish were moved to the laboratory from the farm on the same date. The members of this group were survivors of a full clinical outbreak of PKD. Water temperatues were maintained at 16 C. In spite of the summer temperatures, the fish did recover, but perhaps more slowly than they would have had the temperature been allowed to drop to winter levels. It was concluded that the development of PKD is closely associated with water temperatures, but that recovery is less temperature dependent. (Baker-FRC)
W81-05257

DECOMPOSITION OF WATER HYACINTH IN AGRICULTURAL DRAINAGE WATER.
Florida Univ., Sanford. Agricultural Research and Education Center.
K. R. Reddy, and P. D. Sacco.
Journal of Environmental Quality, Vol 10, No 2, p 228-234, 1981. 5 Fig, 6 Tab, 21 Ref.

Descriptors: *Water hyacinth, *Decomposition, *Nutrients, Aerobic conditions, Anaerobic conditions, Nitrogen, Phosphorus, Chemical oxygen demand, Biological oxygen demand, Drainage canals, Dissolved oxygen.

This study evaluated the release of selected nutrients from decomposing water hyacinths under aerobic and anaerobic conditions. Also, the impact of water hyacinth decomposition on drainage canal water quality was evaluated. Nutrients release from the decomposing plants was measured in a laboratory incubation study. Under both aerobic and anaerobic systems, about 21-45% of the added nitrogen was lost, which resulted in low accumulation of inorganic N. At all levels of water hyacinths tested, soluble P release into the water was higher under anaerobic conditions than aerobic. After 100 days of decompostion, chemical oxygen demand of the water hyacinth treated water was reduced by 42 to 73% under aerobic conditions and by 16 to 57% under anaerobic condtions. Biological oxygen demand was reduced 67 to 85% under aerobic conditions and 20-53% under anaerobic conditions. Under field conditions, water hyacinth die-off after herbicide application was studied. There was an increase in the concentrations of soluble N and P in the canal water. (Small-FRC)
W81-05267

AEROMONAS HYDROPHILA: ECOLOGY AND TOXIGENICITY OF ISOLATES FROM AN ESTUARY.
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W81-05275

BIOAVAILABILITY OF MERCURY IN SEVERAL NORTH-EASTERN U.S. SPARTINA ECOSYSTEMS,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5B.
W81-05286

SOME EFFECTS OF THE DISCHARGE OF CHLORINATED SEWAGE, FROM A SHORT SEA-OUTFALL, ON INTERTIDAL MACRO-ORGANISMS,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
For primary bibliographic entry see Field 2L.
W81-05294

GROWTH RESPONSE OF FOUR MICRO-ALGAE TO THREE CRUDE OILS AND A FURNACE OIL
Banaras Hindu Univ., Varanasi (India). Center for Advanced Studies in Botany.
J. P. Gaur, and H. D. Kumar.
Environmental Pollution (Series A), Vol 25, No 1, p 77-85, 1981. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Algae, Oil spills, *Toxicity, Ecosystems, Ecology, Aquatic environment, Aquatic life, Aquatic plants, Benthic flora, Industrial wastes, Oily water, Oil pollution, *Crude oil, Comparison studies, Oil grades.

Four micro-algae were exposed to three crude oils. The algae used were Anacystis nidulans, Selenastrum capricornutum, Chlorella vulgaris, and Oocystis sp. The growth of A. nidulans depended on the type of oil as well as on its concentration in the culture suspension. Chlorella vulgaris exhibited marked to tolerance to various oils but, like A nidulans, was particularly sensitive to furnace oil. Selenastrum capricornutum was particularly sensitive to the test oils. Furnace oil caused the most inhibition, with other test oils being slightly less toxic. Oocystis sp. had a marked capacity to withstand the toxic effects of the various test oils but was markedly sensitive to furnace oil. This study thereby demonstrated that algae differ widely with regard to their tolerance to and growth in oils. The species-specific toxicity of oils and their products may produce deleterious effects by favoring the growth of resistant forms and eliminating the susceptible ones. This might eventually affect the structure and functioning of aquatic ecosystems. (Baker-FRC)
W81-05295

UPTAKE OF THE HERBICIDE PENDIMETHALIN BY THE SEA NETTLE CHRYSAORA QUINQUECIRRHA,
Maryland Univ. Baltimore. Div. of Dermatology.
For primary bibliographic entry see Field 5B.
W81-05301

TOLERANCE OF HEADWATER VS. MAINSTREAM FISHERS FOR ABRUPT PHYSICO-CHEMICAL CHANGES,
Roanoke Coll., Salem, VA. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W81-05302

5D. Waste Treatment Processes

IMPROVING MUNICIPAL AND INDUSTRIAL WASTE TREATMENT PROCESSES: NUTRITIONAL AND PHYSICAL CONDITIONS THAT REGULATE FLOC FORMATION IN BACTERIA ISOLATED FROM ACTIVATED SLUDGE,
Alabama Univ., Birmingham. Dept. of Biology.
J. J. Gauthier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246282, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, June 30, 1981. 41 p, 13 Fig, 9 Tab, 57 Ref. OWRT-A-068-ALA(1), 14-34-0001-9101.

Descriptors: *Sludge, *Microorganisms, Wastewater, Floc formation, *Activated sludge process, *Flocculation, *Wastewater treatment, Industrial wastewater, Municipal wastewater.

In the activated sludge process, microorganisms are separated from the treated wastewater by settling in a clarifier. Sludge settling is dependent upon the ability of the microbes in the mixed liquor to adhere to one another. This project was directed toward a better understanding of the mechanisms by which sludge microorganisms form floc. Several zoogloeal isolates, obtained from both municipal and industrial sludge, were tested for flocculating efficiency when they were grown to the logarithmic and stationary phase.
W81-05004

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE STEAM ELECTRIC POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 6E.
W81-05026

1980 NEEDS SURVEY; COST ESTIMATES FOR CONSTRUCTION OF PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES.
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-193625, Price codes: A05 in paper copy, A01 in microfiche. Report 430/9-81-001, February, 1981. 96 p, 1 Fig, 57 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Construction costs, *Planning, Municipal wastes, Cost analysis, Projections, Sewer systems, Advanced wastewater treatment, Rural areas, Urban areas.

Detailed estimates of the costs of construction of all needed publicly-owned treatment works in all of the states, and in each state are presented, with estimates of current expenditures for municipal waste treatment nationally, and projections of these costs to the year 2000. Since the 1978 survey a decrease in total treatment needs of $9 billion (23%) has occurred. The present survey indicates a total remaining need of $34.5 billion for treatment plants, with a further $85.5 billion required for additional Clean Water Act eligibilities, such as interceptor sewers, collection sewers, and control of combined sewer overflows. A more focused strategy will be more effective in achieving the treatment goals. Great attention has been given to advanced treatment projects resulting in a marked drop in treatment levels greater than secondary. Rural areas and large cities have greater needs than proportional to their populations. (Brambley-SRC)
W81-05032

DEVELOPMENT DOCUMENT FOR THE PORCELAIN ENAMELING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-201527, Price codes: A22 in paper copy, A01 in microfiche. Report EPA-440/1-81-072-b, January, 1981. 534 p, 62 Fig, 170 Tab, 81 Ref.

Descriptors: *Porcelain enameling industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Effluents, Pollutants, Costs, Heavy metals, Suspended solids, Oil, Grease, Fluorides, Cyanide, Zero discharge, Water pollution control, Standards.

The porcelain enameling category has been divided into four subcategories, based on basis material - steel, cast iron, aluminum, and copper. Wastewater results from rinsing the metal surface and is proportional to the surface cleaned and coated so area is used as the production normalizing parameter. BPT limitations for all subcategories are proposed for antimony, arsenic, chromium, copper, lead, nickel, selenium, zinc, aluminum, cobalt, fluoride, iron, titanium, oil and grease, total suspended solids, and pH. Cyanide is included for the aluminum basis subcategory. BAT limitations are given for all pollutants but oil and grease, total suspended solids, and pH. Effluent standards are proposed for new sources (NSPS), and pretreatment standards for existing and new sources. Zero discharges are proposed for the cast iron subcategory NSPS and PSNS. Cost estimates of implementing the wastewater treatment and control options for each subcategory are presented. (Brambley-SRC)
W81-05034

CONSTRUCTION COSTS FOR MUNICIPAL WASTEWATER CONVEYANCE SYSTEMS: 1973-1979.
Murphy (Sage) and Associates, Inc., Denver, CO.
Environmental Protection Agency Report 430/9-81-003, January, 1981. 118 p, 6 Fig, 55 Tab, 7 Append.

Descriptors: *Wastewater facilities, *Construction costs, *Conveyance structures, *Cost analysis, Rural areas, Interceptor sewers, Pumping plants, Construction materials, Water transport, Planning.

This report presents the results of a study of the costs for construction of municipally owned wastewater collection systems, defined as gravity collection systems, interceptors, pumping stations, and associated force mains necessary to collect and transport wastewater to a treatment facility. It is intended to serve as a record of costs for those administering the Construction Grants Program, and to estimate collection costs for engineers, planners, sewerage authorities, and the public. It updates and replaces the previous report in this series, and now includes data on 777 collection systems. The projects are located in all 48 contiguous states excluding Kentucky, and have a construction cost value of $2.02 billion, adjusted to first quarter 1979 dollars. Over 30% of the projects served communities with populations below 2,500 people. Reinforced concrete was the most commonly used pipe, followed by vitrified clay. Unit costs seem to be less for projects outside Standard Metropolitan Statistical Areas, although Step 1 and Step 2 non-construction costs are higher in these areas. (Brambley-SRC)
W81-05035

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT, STANDARDS FOR THE PULP, PAPER AND PAPERBOARD AND THE BUILDERS' PAPER AND BOARD MILLS POINT SOURCE CATEGORIES.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-201535, Price codes: A99 ($44.00) in paper copy, A01 in microfiche. Report EPA-440/1-80/025-b, December, 1980. 660 p, 65 Fig, 179 Tab, 214 Ref, 3 Append.

Descriptors: *Pulp and paper industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Pollutants, Effluents, Biochemical oxygen demand, Suspended solids, Phenols, Chlorinated hydrocarbons, Zinc, Hydrogen ion concentration, *Water quality control, Standards.

For the purpose of establishing BPT, BCT, BAT, NSPS, PSES, and PSNS effluent limitations, the integrated, secondary fibers, and nonintegrated segments of the pulp, paper and paperboard and builders' paper and board mills point source categories have been sub-categorized. BPT and BCT limitations are proposed for all categories for 5-day BOD, total suspended solids, and pH, and BAT limitations are proposed for chloroform, pentachlorophenol, trichlorophenol, and zinc. These seven pollution parameters are limited in the proposed NSPS regulations. PSES and PSNS limitations are proposed for pentachlorophenol, trichlorophenol, and zinc. The BCT limitations are expected to reduce the discharge of 5-day BOD and total suspended solids by 37% from the BPT levels. The financial and energy costs of implementing the regulations are estimated. (Brambley-SRC)
W81-05036

TREATABILITY STUDIES FOR THE INORGANIC CHEMICALS MANUFACTURING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/103, July, 1980. 249 p, 56 Fig, 65 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Chemical wastes, *Inorganic chemicals, *Water pollution sources, *Water pollution control, Effluents, Regulations, Toxicity, Aeration, Filtration, Chemical precipitation, Oxidation, Reduction, Hydrofluoric acid, Chromium compounds, Nickel sulfate, Copper sulfate, Titanium dioxide, Sodium bisulfite, Sodium hydrosulfite.

The major purpose underlying this Treatability Study is to evaluate the achievable performance of proposed Best Available Technologies (BAT) for the treatment and control of pollutant discharges, and to provide empirical treatment system performance information applicable to selected inorganic chemical subcategories. The study specifically concentrated on those subcategories in the Inorganic Chemicals Industry for which analytical data on raw waste waters and treated effluents either do not exist or are deficient, and for which data are needed for purposes of comparison with proposed effluent limitations currently being proposed by the Effluent Guidelines Division of the EPA. This study focuses on available treatment technologies which have been selected as the basis for the proposed BAT regulations. The majority of plants in the particular industries under study practice the BPT (Best Practicable Technology) level of treatment in accordance with existing or previous regulations. In most cases, the BAT level of treatment can be achieved by adding onto the BPT systems a final polishing step designed to remove additional toxic metals and other pollutants of concern for the process waste streams. The control technologies considered were aeration, filtration, precipitation of hydroxides, precipitation of sulfides, oxidation, chromate reduction and fluoride precipitation, and the subcategories tested were hydrofluoric acid/aluminum fluoride, chlor-alkali, chrome pigments, sodium dichromate, nickel sulfate, copper sulfate, sodium bisulfite, sodium hydrosulfite, and titanium dioxide. The proposed BAT regulations appear to be applicable to nickel sulfate, copper sulfate, titanium dioxide, and sodium bisulfite. (Brambley-SRC)
W81-05042

DESIGN HANDBOOK FOR AUTOMATION OF ACTIVATED SLUDGE WASTEWATER TREATMENT PLANTS,
EMA, Inc., St. Paul, MN.
A. W. Manning, and D. M. Dobs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118382, Price codes: A19 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/8-80-028, August, 1980. 426 p, 85 Fig, 22 Tab, 104 Ref.

Descriptors: *Automation, *Activated sludge process, *Wastewater treatment, *Process control, *Systems engineering, Design criteria, Instrumentation, Cost analysis, Management planning, Water pollution control.

A primary method for achieving cost effective abatement of water pollution is optimization of process and system control in wastewater treatment plants. Process control on a real-time basis is of vital concern because the quantity and quality characteristics of municipal wastewater exhibit significant time variation. Cost effective process control can now best be achieved by design of process unit capacity dose to the limit, and the use of small highly skilled operation staffs, aided by the extensive use of instrumentation and automation. The key factor in this new process control optimization philosophy is the effective application of instrumentation and automation techniques. This report is a system engineering handbook for the automation of activated sludge wastewater treatment processes. Successful unit process control strategies currently in use are discussed, and alternative methods of control and implementation are presented where other considerations such as reliability or flexibility are important. A method for preparing a cost effective analysis is detailed through the use of examples. The design guide section reviews some of the aspects of control system design and includes examples of documentation required to convey the engineer's and user's requirements. A hindrance to the fruitful application of instrumentation and automation in the field is a lack of application of effective modern management techniques to municipal wastewater control organizations. (Moore-SRC)
W81-05043

EVALUATION OF FULL-SCALE SUGAR BEET TRANSPORT WATER SOLIDS DEWATERING SYSTEM,
Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
M. F. Figueroa, F. A. Brunner, F. S. Williams, and J. C. Buzzell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-205826, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-089, May, 1980. 121 p, 13 Fig, 17 Tab, 16 Ref, 4 Append.

Descriptors: *Wastewater treatment, *Beets, *Dewatering, *Industrial wastewater, *Sludge drying, Water transport, Clarification, Mud, Filtration.

The objectives of this study were to evaluate a full-scale vacuum filtration system for dewatering solids removed from the transport water in an operating beet sugar plant in terms of operational reliability and efficiency, economics, and ultimate disposal of the dewatered solids. At the plant study site (MINN-DAK Farmers Cooperative, Wahpeton, North Dakota), the solids in the beet transport water are removed in a clarifier and piped to the Mud House. Waste lime mud from the sugar processing is added to the clarifier underflow to serve as a filter aid. The combined sludge is dewatered on two vacuum filters. The filter cake is pumped to a storage lagoon adjacent to the Mud House. Study findings indicate that the solids handling system was not functioning as intended, largely because the clarifier did not provide sufficient thickening. The vacuum filters received primarily waste lime mud; the clarifier underflow largely bypassed the Mud House and went directly to a storage lagoon. Mud House operations were adjusted to compensate for the various difficulties, resulting in bypass of most of the clarifier underflow. Because the solids handling system was not functioning as intended, the economic evaluation was not carried out. Instead, the various components of the total system were evaluated and modifications are presented that can be implemented to improve the system so that the original goals for the system can be achieved.
W81-05046

EVALUATION OF AMMONIA 'FIXATION' COMPONENTS IN ACTUAL REFINERY SOUR WATERS.
American Petroleum Institute, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203623, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-081, May, 1980. 122 p, 19 Fig, 18 Tab, 16 Ref, 8 Append.

Descriptors: *Ammonia, *Wastewater treatment, *Industrial wastewater, Economic analysis, Cyanide, Chemical treatment, Stripping, Organic acids, Steam.

Ammonia fixation is a term used to describe the occurrence of ammonia in stripped sour waters (SSW) that is resistant to removal by means of additional steam. Samples of refinery SSW were analyzed for organic components, oxidized sulfur compounds, and heavy metals to determine the cause of ammonia fixation during stripping. Acidic materials were identified that would cause fixation. These acids included thiosulfuric acid, thiocyanic acid, and weak organic acids. In some SSW, ammonia is synthesized during analysis, resulting in an apparent nonstrippable residual ammonia. The amount of ammonia fixation that will occur with a particular sour water can be predicted by batch stripping using nitrogen gas, or by a potentiometric titration. Laboratory stripping experiments were used to demonstrate that caustic can substitute for steam in producing a SSW with low levels of ammonia. An economic analysis showed that caustic use is only warranted when very high ammonia removal (more than 97%) is required, and that the economic optimum steam and caustic usage would degrade sulfide removal performance. Studies with artificial sour waters showed that average refinery stripper operations could remove simple cyanide and convert some cyanide to thiocyanate. Metal-complexed cyanide was largely unaffected by stripping. (Moore-SRC)
W81-05047

SOLVENT EXTRACTION OF WASTEWATERS FROM ACETIC-ACID MANUFACTURE,
California Univ., Berkeley. Dept. of Chemical Engineering.
N. L. Ricker, and C. J. King.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-197577, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-064, April, 1980. 168 p, 16 Fig, 42 Tab, 96 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Acetic acid, Organic solvents, Waste recovery, Cost analysis, Solvents, Chemical industry.

Solvent extraction was evaluated as a potential treatment method for wastewaters generated during the manufacture of acetic acid. Possible goals for an extraction process were considered. For the wastewater samples studied, extraction appeared to be too expensive to be practical unless recovery of a marketable chemical were possible. Longchain, tertiary alkyl amines, dissolved in organic diluents, appeared to be the most promising extractants, except for certain wastewaters containing chlorinated acetaldehydes. Amine extractants were studied extensively in small-scale experiments to determine phase equilibria, extractant regenerability, mass-transfer characteristics, and emulsification tendencies. A cost estimate was prepared for an extraction process to recover acetic acid from a 22,700-kg/h (100-gpm) wastewater containing 5 wt.% acid. Estimated direct-fixed-capital was $1,030,000, with an annual operating cost of $253,000/year ($5.90/1000 gal), resulting in a return on investment before taxes (ROIBT) of 244% per year. The ROIBT, for a 1 wt.% acetic acid wastewater was only about 30%; however, this might be increased by further optimization of the amine/diluent combination.
W81-05048

SOURCES AND TREATMENT OF WASTEWATER IN THE NONFERROUS METALS INDUSTRY,
Radian Corp., Austin, TX.
R. T. Coleman, J. D. Colley, R. F. Klausmeier, N. P. Meserole, and W. C. Micheletti.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-196918, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/2-80-074, April, 1980. 172 p, 14 Fig, 47 Tab, 67 Ref, 1 Append.

Descriptors: *Heavy metals, *Industrial wastes, *Wastewater treatment, *Nonferrous metals industry, Copper, Lead, Zinc, Chemical precipitation, Evaporation, Recycling, Starch complexing, Reduction.

Industrial effluent waters containing dissolved heavy metals represent an environmental problem associated with the activities of many industries. The available literature data were compiled on both the sources of and treatment technologies for industrial acidic wastewater containing dissolved heavy metals, in order to assess the applicability of existing wastewater treatment technology to the effluents generated by the primary and secondary copper, lead, and zinc industries. Two treatment processes, hydroxide precipitation and evaporation were found to be widely used commercially and applicable to the treatment of effluents in the nonferrous metals industry. The applicability of evaporation is limited to arid regions. Sulfide precipitation and ferrite coprecipitation have been successfully used in limited applications. The solid waste that is generated can be recycled to a smelting furnace. The sodium borohydride reduction process may be useful for small wastewater streams containing either valuable or hard to remove metals. Starch complexing has been applied in pilot studies as a polishing process. Good removal efficiencies are reported, but the solid waste that is generated when absorbed compounds are released upon decomposition of the starch results in a concentrated stream which must be treated by other means. (Moore-SRC)
W81-05049

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE BATTERY MANUFACTURING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-400/1-80/067-2, September, 1980. 847 p, 150 Fig, 186 Tab, 124 Ref.

Descriptors: *Industrial wastes, *Water pollution sources, *Battery industry, *Wastewater treatment, *Water pollution control, Water quality standards, Heavy metals, Costs, Pollutants, Process control, Water use, Zero discharge, Clean Water Act.

This report is a technical background document prepared to support effluent limitations and standards under authority of the Clean Water Act. Based on the battery anode material the industry was subcategorized into the following groups: cadmium, calcium, lead, Leclanche, lithium, magnesium, zinc, and nuclear. Wastewater generation, water use, and mass discharge were determined for each subcategory. Control and treatment technologies are available as end-of-pipe treatment and in-process pollution control techniques. Costs are estimated for individual treatments and treatment systems. The best practicable technology (BPT) for control of heavy metals in each of the subcategories is identified and used as a basis for developing best available technology (BAT). Zero discharge of process wastewater pollutants is achievable by BPT for the Leclanche subcategory, and by BAT for the cadmium subcategory. For all subcategories the BAT options provide methods for reducing both the volume of process wastewater and the concentrations of pollutants, and may include the elimination of wastewater discharge from specific process elements. (Brambley-SRC)
W81-05062

DRAFT DEVELOPMENT DOCUMENT FOR THE ELECTRICAL AND ELECTRONIC COMPONENTS POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W81-05063

DEVELOPMENT DOCUMENT FOR THE COIL COATING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W81-05064

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE COAL MINING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W81-05065

AN ECONOMIC ANALYSIS OF EFFLUENT STANDARDS FOR BOD, AMMONIA, TOTAL SUSPENDED SOLIDS, AND DISINFECTION: CASE STUDY OF A MODERN TREATMENT PLANT.
Hey (Donald L.) and Associates, Chicago, IL.
D. L. Hey, J. M. Pappas, and L. C. Cox.
Illinois Institute of Natural Resources, Chicago, Document No 80/25, November, 1980. 46 p, 8 Fig, 22 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Cost-benefit analysis, *Water quality standards, Water pollution effects, *Water pollution control, *Chlorination, Economic aspects, Sanitation, Estimated costs, Environmental protection, Effluent, Swimming, Economic evaluation.

Implementing stricter effluent standards for municipal wastewater plants involves immense costs, and the benefits are not always obvious or of more than a seasonal nature. Unfortunately, little information is available concerning the economic value of potential uses. The Illinois EPA is addressing the relationship between effluent limits and the existing and potential uses of streams in Illinois through its review of existing stream standards. The case cited is the Downers Grove Sanitary District which will need to spend approximately $2 million for additional facilities to meet the ammonia effluent standard of 1.5 mg/liter. The report suggests that the economic principals of marginal analysis are meaningful when waste disposal is displacing or preventing other uses, and concludes: (1) Variable effluent limits would reduce operating costs by 21 percent according to the cost analysis of the Downers Grove treatment plant. Assuming the elimination of chlorination and fixed effluent limits, the operating cost would be reduced by $266,000. (2) The seasonal standard for BOD accounts for 12 percent of the savings; ammonia accounts for 39 percent; microstrainers represent 8 percent; and elimination of chlorination would account for 41 percent, and would also save about 2 million kwh. (3) Return on investment, even with variable effluent limits, is not commensurate with operating or facility costs. (4) Regardless of effluent limits, achievement of a higher use for affected streams is unlikely. (5) Variable limits are recommended, but in-stream treatment is a possible alternative. (6) Chlorination should continue near swimming areas. (Garrison-Omniplan)
W81-05067

AERATION SYSTEM AND METHOD WITH TAPERED NOZZLE.
Clevepak Corp., White Plains, NY. (Assignee).
A. E. Molvar.
U.S. Patent No 4,224,158, 7 p, 3 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P 1455, September 23, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Aeration, Equipment, Bubbles, Gases, Flow rates, Mixing, Gas-water interfaces.

A system is described for mixing gas with wastewater in which the water is pumped through a number of mixing chambers into which the gas is injected at a step region to form parallel streams of gas and water. An extending chamber contains the parallel streams as the interface between them becomes unstable, breaks down, creating vortices and produces tiny bubbles which mix with the water. The extending chamber is divided into two section with at least the section remote from the step surface tapered inwardly at a rate of 11-22 degrees to permit operation at high air flow rates without blowing the bubble forming vortices out of the chamber. (Sinha-OEIS)
W81-05072

WEIR SKIMMER.
Nalco Chemical Co., Oak Brook, IL. (Assignee).
D. G. Pardikes, W. F. Flowers, A. S. Huff, and A. J. Young.
U.S. Patent No 4,224, 156, 6 p, 3 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P 1454, September 23, 1980.

Descriptors: *Patents, *Wastewater treatment, *Mine wastes, *Water pollution treatment, Separation techniques, Settling basins, Weirs, Flocculation, Overflow, Automatic control, Skimming.

Many approaches have been used to contain and treat mine drainage and waters. Among the types of technology used there is a ponding and settling system that relies on natural or man-made grades that occur in the topography of the surrounding areas. Grading of the land allows for the collection of water into pond systems for its retention and treatment. Separation of suspended matter from water can be improved by treating the water with various types of polyelectrolytes. One of the problems that has been observed in the use of polyelectrolytes is the control of the feeding rate into a water suspension pond while its volume is varying under conditions of rainfall or in extreme flooding. Under these types of conditions as well as under drought conditions when essentially no water flow exists, the treatment is often inadequate due to either gross under-treatment in relation to the amount of polyelectrolyte needed to efficiently remove suspended matter or gross over-treatment which is wasteful and costly to the operator. An object of this invention is to provide an apparatus and procedure for controlling the amount and quality of effluent waters being discharged from an industrial mine site. Another object is to provide automatic control to stop the feed of polyelectrolyte when it is not needed due to low water conditions in the pond. A further object is to provide a device that can accomplish this in such a manner as to de-emphasize the necessity of operators. (Sinha-OEIS)
W81-05073

SEWAGE TREATMENT APPARATUS.
G. A. Milne.
U.S. Patent No 4,224,155, 9 p, 11 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P 1454, September 23, 1980.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, *Separation techniques, Aerobic treatment, Aeration, Equipment, Underground.

The invention provides a totally self-contained underground aerobic digestive system for wastewater treatment. The system is entirely underground so that no ground space is consumed by operation of the facilities and so that no noxious odors or visual pollution is produced by the system. The system is completely aerobic and no preliminary anaerobic sludge treatment is provided. Waste water flows directly into a receiver which has a foraminous wall in an upper portion for passing wastewater with dissolved materials and with suspended solids. Large objects, undigestable solids and heavy grits are retained within the receiver. When the receiver is full of solids, wastewater flows through larger apertures in the holder. Several tanks are coupled in parallel or series. The tanks are provided with aeration devices in a main portion and have a partition which forms a chlorifying portion with a sludge return at the bottom of the partition and a skimmer return at the top. Multiple tanks are arranged in parallel or series. Outflow of the tanks is cascaded in an enclosure and is dispersed in injection wells. De-watering systems remove sludge from the bottom of the tank and return sludge to the inflow for further treatment. The entire self-contained system can be located beneath the parking lot adjacent a multiple dwelling unit. (Sinha-OEIS)
W81-05074

PROCESS FOR CLARIFYING AQUEOUS SYSTEMS EMPLOYING QUARTERNARY AMMONIUM ADDUCTS OF POLYMERIZABLE TERTIARY AMMONIUM SALTS AND ACRYLAMIDE.
Petrolite Corp., St. Louis, MO. (Assignee).
R. S. Buriks, A. R. Fauke, and D. W. Griffiths.
U.S. Patent No 4,224,150, 8 p, 3 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P 1452, September 23, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Separation techniques, Water purification, Flocculation, Oil pollution, Suspended solids, Chemical reactions, Polymers, Turbidity, Clarification.

This invention relates to adducts of salts of polymerizable tertiary amines with acrylic compounds illustrated by acrylamide and acrylonitrile; to polymers and copolymers containing said adducts and to processes for preparing them. The invention also relates to the use of the polymers and copolymers, particularly in the clarification of turbid waters by flocculation or flotation of oil and/or suspended solids. (Sinha-OEIS)
W81-05076

RECLAMATION OF MOLYBDENUM OR OTHER HEAVY METALS FROM WASTEWATER TREATMENT SKIMMINGS.
Dravo Corp., Pittsburgh, PA. (Assignee).
E. R. Ramirez.
U.S. Patent No 4,222,872, 3 p, 7 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 1025, September 16, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, *Heavy metals, Skimming, Chemical reactions, Chemical precipitation, Molybdenum, Tungsten, Product recovery.

Heavy metal anions such as molybdenum and tungsten are reclaimed from wastewater skimmings and ferric sulfate recovered for future use. The skimmings result from precipitation of heavy metals from wastewater, such as mine tailings, by contact with ferric sulfate to form insoluble ferric salts with subsequent gas flotation. The wastewater skimmings are contacted with aqueous caustic at a temperature of between 150 degree-225 degree F. to dissolve the heavy metal anions and form a solution and residual solids. The heavy metal anion solution is separated from the residual solids and they in turn are contacted with sulfuric acid to produce ferric sulfate which is then used to form additional wastewater skimmings. (Sinha-OEIS)
W81-05084

LAGOONING PROPERTIES OF FLUSHED DIARY AND SWINE WASTES IN MULTI-CELL SYSTEMS EMPLOYING RECYCLE.
Auburn Univ., AL. Dept. of Agricultural Engineering.
D. T. Hill, T. A. McCaskey, and H. E. Hamilton.
Transactions of the ASAE, Vol 24, No 2, p 459-464, March-April, 1981. 10 Fig, 3 Tab, 17 Ref.

Descriptors: *Animal wastes, *Lagoons, *Farm lagoons, Waste treatment, Agricultural wastes, Farm wastes, Hogs, Dairy industry, Nitrogen compounds, Bacteria, Pathogenic bacteria, Salts, Sludge.

Three years of studies in laboratory scale lagoon simulators showed striking differences between la-

gooning characteristics of swine wastes and settled dairy wastes. Operating parameters were as close as possible to field conditions. Dairy wastes are high in undigested plant material, low in N (3.9% TKN), lower in pH, and higher in volatile organic acids than swine wastes. Salt concentration buidlup at a loading rate of 320 g volatile solids per cu meter per day was greater in swine waste, 1.73% NaCl, vs. 0.2% for dairy waste. Nitrogen loss was 80% for lagooned dairy waste and 55% for swine waste. Salmonella typhimurium decreased more rapidly in lagooned dairy waste than in swine waste; bacteria were eliminated in both systems after 32 days. Volatile solids reduction was 1.15 times greater in swine waste than in dairy waste. Sludge accumulation rates in the first cell were 4.2-22.15% per year of total lagoon volume for dairy waste and 17.72-33.3% per year for swine waste. Sludge accumulation in the second cells was no problem. The swine lagoon systems using recycle had a sludge accumulation rate of 18.9% per year, and a useful life of 4-5 years for the cell and 10.15 years for the total system. For dairy waste, an accumulation rate of 8.44% per year and a useful life of 10 years for the first cell were determined. The total system life is almost indefinite if the second cell is also allowed to fill with sludge. Both wastes were similar in carbon content and degree of treatment possible for loading rates up to 160 g volatile solids per cu meter per day. (Cassar-FRC)
W81-05125

PRECIPITATION MINUS EVAPORATION DATA FOR LAGOON DESIGN AND MANAGEMENT IN THE CENTRAL AND SOUTHEASTERN UNITED STATES.
Missouri Agricultural Experiment Station, Columbia.
For primary bibliographic entry see Field 2B.
W81-05127

SOME OBSERVATIONS ON THE BIOCHEMISTRY AND INHIBITION OF NITRIFICATION.
Anglian Water Authority (England).
L. B. Wood, B. J. E. Hurley, and P. J. Matthews.
Water Research, Vol 15, No 5, p 543-551, May, 1981. 1 Fig, 7 Tab, 45 Ref.

Descriptors: *Nitrification, *Inhibitors, *Activated sludge, *Wastewater treatment, Organic compounds, Thiourea, Enzymes, Toxicity, Nitrogen compounds, Nitrosomonas, Ammonia, Nitrites, Nitrates.

Activated sludge mixed liquors were aerated in the presence of measured amounts of compounds potentially toxic to nitrification. Examination of thiourea and its analogs (especially inhibitory compounds) further supported the theory that enzymic Cu(1+) chelation is the main cause of nitrification inhibition for compounds producing the most marked effects. Percent nitrification inhibition of concentrations of one to 10 times 10 to the minus 6th molar, as calculated by ammonia loss, were: thiourea, 77%; allyl thiourea, 38%; methyl thiourea, 100%; and amino thiourea (thiosemicarbazide), 79%. The following compounds had an inhibitory effect on nitrification (concentrations 10 to 330 mg per liter): sodium salts of pentabromophenol, 2,4,6-tribromophenol, Bisphenol A, and 2,3,5',6'-tetrabromo Bisphenol A; 2,4,6-tribromophenol; bromodichloropropane; 2,3-dibromopropan-1-ol; 1,2-dibromoethane: and chlorobenzene. Compounds with no effect on nitrification (concentrations on the order of 50 to 300 mg per liter) were: tribromophenyl allyl ether, pentabromophenyl allyl ether, pentabromotoluene, allyl chloride, decyl bromide, tris (2,3-dibromopropyl) phosphate, diphenyl, terphenyl, decabromodiphenyl, and tetradecabromoterphenyl. Results from three different mixed liquors varied significantly; therefore, results should be interpreted with care. Loss or organic nitrogen is explained by the reduction of nitrite by a copper-containing hydroxylamine-nitrite reductase in Nitrosomonas, which is inhibited by the compounds detrimental to nitrification. (Cassar-FRC)
W81-05152

PILOT-SCALE EVALUATION OF DESIGN CRITERIA FOR ANAEROBIC PHOTOSYNTHETIC LAGOONS TREATING FELLMONGERY (UNHAIRING) WASTEWATER,
Massey Univ., Palmerston North (New Zealand). Dept. of Biotechnology.
P. N. McFarlane, and H. Melcer.
Water Research, No 15, No 5, p 609-613, May, 1981. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Anaerobic lagoons, *Sulfur bacteria, *Leather industry, *Industrial wastewater, Wastewater treatment, Wastewater lagoons, Lagoons, Sheep, Chromatiaceae, Bacteria, Microorganisms, Chemical oxygen demand, Sulfides, Fellmongery wastes, *New Zealand.

Fellmongery wastewater, from the unhairing of sheep pelts, was treated in a pilot-scale (4.7 cu meter) anaerobic photosynthetic lagoon in which Chromatiaceae, purple sulfur bacteria, were the dominant organisms. A ninety-day retention time produced removals of 86% COD and 85% sulfide; original levels were about 4500 mg per liter COD and about 98 mg per liter sulfide. pH was reduced from 12 to eight. Results on effluent quality obtained in this study compared well with predictions based on laboratory scale models. (Cassar-FRC)
W81-05154

EFFECT OF TEMPERATURE AND DISSOLVED OXYGEN ON BIODEGRADATION OF NITRILOTRIACETATE,
Procter and Gamble Co., Cincinnati, OH.
R. J. Larson, G. G. Clinckemaille, and L. Van Belle.
Water Research, Vol 15, No 5, p 615-620, May, 1981. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Nitrilotriacetate, *Dissolved oxygen, *Temperature, *Biodegradation, Oxygen, Fate of pollutants, Microorganisms, *Wastewater treatment, Degradation.

The rate of biodegradation of nitrilotriacetate (NTA) was determined in water samples collected from the Ruhr River in an area where NTA-containing detergents are not used. Half-lives were two days for Ruhr River samples and one day for river water from NTA-using areas. First order rate constants showed temperature dependence (coefficient, two), and biodegradation occurred over the range 2-24 degree C. The effect of temperature on the rate of NTA degradation was described by the Arrhenius equation, with calculated activation energies in the range reported for ordinary enzyme reactions. Biodegradation of NTA occurred at concentrations as low as 50 micrograms per liter and over a dissolved oxygen concentration range of 0.3 to 13 mg per liter. The initial steps in biodegradation were oxygen dependent, suggesting an obligate oxygen requirement for the initial steps. (Cassar-FRC)
W81-05155

ACID AND ALKALINE PHOSPHATASE ACTIVITY IN ANAEROBIC DIGESTED SLUDGE: A BIOCHEMICAL PREDICTOR OF DIGESTER FAILURE,
York Univ. (England). Dept. of Biology.
N. V. Ashley, and T. J. Hurst.
Water Research, Vol 15, No 5, p 633-638, May, 1981. 9 Fig, 2 Tab, 7 Ref.

Descriptors: *Anaerobic digestion, *Digestion, *Phosphatase activity, Enzymes, Biological treatment, Sludge digestion, Indicators, Acidity, Methane, *Wastewater treatment, Fatty acids, Bacteria.

Increases in acid and alkaline phosphatase activities were good indicators of instability or incipient failure of a laboratory-scale anaerobic sludge digester. These changes were apparent days before the usual tests for fatty acids or methane production disturbances were possible. The pH optima of four different phosphatase activities in digesting sludge were 4.2, 6.6, 9.4, and 11.4. At the highest feed rate, 200 ml per day, dramatic increases in all four phosphatases were detectable at the beginning of the increased feed rate (36th day) and again at 86-90 days. Increases in volatile fatty acids and a fall in pH were not apparent until 95-100 days. Methane levels were not affected at this stage. Addition of monochloroacetic acid to destabilize the digester caused an immediate rise in phosphatase activity at a point where methane production remained stable. Increases in acetic and propionic acids occurred two days after phosphatase changes, and higher molecular weight acids did not appear until the fifth day. (Cassar-FRC)
W81-05156

THE DROPLET SIZE AND HEIGHT EFFECTS IN AMMONIA REMOVAL IN A SPRAY TOWER,
Caulfield Inst. of Tech. (Australia).
T. H. Davies, and S. Y. Ip.
Water Research, Vol 15, No 5, p 525-533, May, 1981. 6 Fig, 8 Tab, 4 Ref.

Descriptors: *Ammonia, *Aeration, *Spraying, *Wastewater treatment, Mass transfer, Lime, Pilot plants.

Ammonia was removed from lime treated sewage by spraying down through an unpacked air stripping tower. The pilot plant study determined that the instantaneous ammonia release at the spray nozzle depended on nozzle design. Optimum median droplet diameter was 1300-1400 micrometers. Ammonia removal efficiency varied with tower height according to an equation which allowed assessment of cost and benefits for increased tower heights. A No. 50 nozzle at a delivery pressure of 276 kPa removed about 19% of the ammonia instantaneously, followed by further removal dependent on the liquid/gas ratio, tower height, and temperature. A No. 60 nozzle removed 13% of the ammonia initially. It was also determined that a large diameter tower with little spray contacting the walls was most efficient. (Cassar-FRC)
W81-05161

COST REDUCTIONS DUE TO SEASONAL VARIATION IN MUNICIPAL WASTE WATER TREATMENT LEVELS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W81-05171

TREATMENT PROCESSES TO MEET WATER REUSE REQUIREMENTS,
Culp/Wesner/Culp, Cameron Park, CA.
R. L. Culp.
Water/Engineering and Management, Vol 128, No 4, p 72, 74-76. April, 1981. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Water reuse, *Recharge, Injection, Injection wells, Wastewater renovation, Water use, Land disposal, Nitrogen, Economic aspects, Public opinion, Attitudes.

Most water reuse projects will be developed in areas of the country where water shortages may be occurring in the future. There must be a definite need, or such a project will not likely meet with public support. After deciding that there is a need, the next problem is to define to what use the reclaimed water will be put. Groundwater recharge may be the most valuable method to use for water which will be used for certain manufacturing processes involving food and drink, for domestic and commercial use, for fisheries, or for other semi-potable or potable uses. The amount of water needed for these high-quality uses is relatively small compared to total water use. Thus the use of groundwater recharge will play a small role in the overall water-supply picture. Prior to the recent concern about trace organics in drinking water, several apparently successful surface spreading recharge projects were developed and operated using secondary effluent. Presently pretreatment requirements between water for surface spreading and well injection differ only in that for surface spreading the disinfection, chemical treatment, filtration, reverse osmosis, and stripping are eliminated. Under certain conditions of spreading the fate of nitrogen may be a problem. Pretreatment costs vary considerably from state to state. The lowest

cost system in California is secondary treatment in aerated lagoons followed by surface spreading. (Baker-FRC)
W81-05194

WATER REUSE--LEARNING ABOUT THE EUROPEAN EXPERIENCE,
S. Miller.
Environmental Science and Technology, Vol 15, No 5, p 499-501, May, 1981. 1 Tab.

Descriptors: *Water reuse, *Potable water, *Water treatment, Wastewater renovation, Public health.

Most industrial European countries reuse water to a considerable degree. In Paris the degree of reuse is 50-70%; in England and Wales, 32%; in the Ruhr River, West Germany, 40% on occasion. Similar situations exist in Spain; Gothenberg, Sweden; and Warsaw, Poland. Only one well-documented case of illness from water containing a high proportion of wastewater has been reported. It happened in Essen, West Germany, in the winter of 1959-60, when 7% of the population suffered a nonbacterial gastroenteritis. Methods of minimizing the undesirable effects of water reuse are: dual systems for drinking water and for industrial and sanitary use, artificial recharge in sand dunes, bankside filtration wells, ozonation, and biological treatment. (Cassar-FRC)
W81-05195

THE USE OF STRAW FOR REMOVAL OF HEAVY METALS FROM WASTE WATER.
Aarhus Univ., Risskov (Denmark). Botanical Inst.
V. J. Larsen, and H. H. Schierup.
Journal of Environmental Quality, Vol 10, No 2, p 188-193, April-June, 1981. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Straw, *Heavy metals, *Chemical precipitation, *Wastewater treatment, Electroplating, Industrial wastes, Performance evaluation, Activated carbon.

The use of straw and a combination of straw and CaCO3 for the removal of heavy metals from wastewater were investigated. The efficiency of straw is also compared to the efficiencies of pine sawdust and activated carbon. Three experiments were carried out: capacity experiments, column experiments, and regeneration experiments. In the capacity experiments, barley straw was preteated as follows: ground (actually referred to as untreated), boiled and washed (referred to as washed), and mixed with pulverized CaCO3 in a 2:1 ration by weight. Activated carbon was more efficient in removing heavy metals than straw or pine sawdust. Straw with CaCO3 removed the most, unwashed straw was second in efficiency, and washed straw was least effective. Removal rates are listed for zinc, copper, lead, nickel, and cadmium. The straw can be regenerated and used several times. The use of straw in combination with precipitation by CaCO3, Na2CO3, NaOH, or Ca(OH)2 could be particularly suitable for small electroplating firms. (Small-FRC)
W81-05273

ONE TECHNIQUE FOR ESTIMATING INFLOW WITH SURCHARGE CONDITIONS.
RJN Environmental Associates, Inc., Wheaton, IL.
For primary bibliographic entry see Field 8B.
W81-05277

MUNICIPAL WASTEWATER TREATMENT WITH THE ANAEROBIC ATTACHED MICROBIAL FILM EXPANDED BED PROCESS,
New York State College of Agriculture and Life Sciences, Ithaca.
W. J. Jewell, M. S. Switzenbaum, and J. W. Morris.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 482-490, April, 1981. 8 Fig, 3 Tab, 28 Ref.

Descriptors: *Anaerobic digestion, *Shock loads, *Organic loading, *Wastewater treatment, Secondary wastewater treatment, Methane, Biological treatment, Chemical oxygen demand, Hydraulic retention.

The anaerobic attached microbial film expanded bed process (AAFEB) was developed to minimize energy input and excess biological solids production while producing energy. The purpose of this study was to improve the deficiencies of the anaerobic methane fermentation process, namely, inability to efficiently treat dilute substrates, decreased organic removal efficiencies at low temperatures, and low resistance to organic shock loadings, temperature fluctuations, and varying flow rates. The AAFEB process at 20 degrees C produced an effluent containing 40 mg liter COD and 5 mg per liter suspended solids from a dilute primary settled wastewater (average COD, 186 mg per liter) at hydraulic retention periods less than 30 min. The anaerobic AFEB followed by aerobic AFEB produced complete nitrification at 15 min retention period; effluent had 10 mg per liter COD, 1 mg per liter suspended solids, and two turbidity units. Maximum organic removal efficiencies were an order of magnitude better than other anaerobic processes; retention periods were two to three magnitudes shorter. Large instantaneous fluctuations of temperature (plus or minus 25 degrees C), hydraulic retention times (7 to 3 to 8.3), COD (850 to 150 to 950 mg per liter) and organic loading rate (1.4 to 4 to 1.7 kg per cu meter per day) did not affect the process. (Cassar-FRC)
W81-05278

UPGRADING WITH ROTATING BIOLOGICAL CONTACTORS FOR BOD REMOVAL,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
C. P. C. Poon, H. K. Chin, E. D. Smith, and W. J. Mikucki.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 474-481, April, 1981. 4 Fig, 26 Ref.

Descriptors: *Effluent standards, *Rotating biological contactors, *Wastewater treatment, Biological treatment, Biological oxygen demand, Trickling filters, Secondary wastewater treatment, Hydraulic loading, Shock loads, Water treatment facilities.

Since many secondary treatment plants are 20 years old, their effluents do not meet current effluent quality standards. Upgrading the plant, rather than undertaking new construction, is a flexible, cost-effective alternative for remedial action. Studies of upgrading with rotating biological contactors (RBC) produced several conclusions based on soluble BOD (SBOD) rather than total BOD. Effluent SBOD5 concentration increases with increased SBOD5 loadings. Suspended solids must be removed from the RBC effluent to meet tertiary effluent standards. SBOD5 removal percentage decreases with decreasing influent SBOD5 concentration. Soluble carbonaceous BOD5 of the effluent remains steady over SBOD5 loadings from two to eight mg per liter. The effluent also contains one to 13 mg per liter soluble nitrogen BOD5, which adds 50 to 160% to the total SBOD5. A correction factor of 0.41 should be applied to determine allowable hydraulic loadings in the case of hydraulic loadings from 0.17 to 0.31 cu meters per sq meters per day. Organic shock loadings up to 15.4 SBOD5 per sq meters per day and peripheral speeds from 0.18 to 0.35 meters per sec have no discernible effect on RBC performance. (Cassar-FRC)
W81-05279

METAL REMOVAL BY ADSORPTION AND PRECIPITATION IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, M. J. Brown, and J. N. Lester.
Environmental Pollution (Series A), Vol 24, No 4, p 313-323. 1981. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Activated sludge process, *Heavy metals, *Wastewater treatment, Adsorption, Precipitation, Filtration, Membrane filters, Flocculation, Lead, Copper, Chromium, Nickel, Manganese, Cobalt, Molybdenum, Process efficiency.

The potential hazards associated with the release of heavy metals to receiving waters have led to considerable interest in the removal of heavy metals during the activated sludge process. A study was performed on the removal of metals by binding, individually and in combination, to activated sludge; the effects of sludge age on metal removal; and the effects of metal concentration on adsorption and precipitation in activated sludge generated from a synthetic sewage. The metals studied included nickel, lead, molybdenum, copper, cadmium, manganese, and chromium. Metals were added to samples of mixed liquor developed in the synthetic sewage, and membrane filtration was then used to separate the soluble and particulate forms of the metals. Precipitation was found to be almost entirely responsible for the removal of chromium (III) and lead, while the removal of predominantly soluble metals was dependent on their absorption by the biomass. The removal efficiencies of the least soluble metals were unaffected by changing sludge age or increasing metal concentration. The predominantly soluble metals responded to sludge age in similar ways, with maximum removal generally occurring at a sludge age or 12 days. Although the percentage removals of the soluble metals decreased with increasing concentrations of the metals, there was no evidence of saturation of the biomass. It is probable that competition of metals for available binding sites would not occur to any great extent over the typical range of metal concentrations in activated sludge. Since the preferential binding of metals to poorly settling particles in activated sludge effluents may be responsible for poor removals of some metals, the efficiency of final settling may be an important factor in metal removal. (Carroll-FRC)
W81-05292

SYSTEM SOLUTIONS TO URBAN WASTEWATER CONTROL,
British Columbia Univ., Vancouver. Div. of Policy Analysis.
For primary bibliographic entry see Field 6A.
W81-05307

ECONOMICS JUSTIFIES COMPUTER-CONTROL FEED,
Autocon Industries, Inc., Minneapolis, MN.
D. L. Ching.
Water and Sewage Works, Vol 127, No 8, p 36-37, 45, 53, August, 1980. 5 Fig, 6 Tab, 2 Ref.

Descriptors: *Computers, *Analog computers, *Digital computers, *Control systems, Instrumentation, Automatic control, Chlorination, Dissolved oxygen, Economics, Cost analysis, *Wastewater treatment, Economic justification.

Three types of chemical feed in wastewater treatment are compared--constant rate, hydraulic load following, and total load following. Feed control may be accomplished by either analog or digital devices. Costs for digital control systems are less than those for analog systems. Digital control systems require less hardware and do not increase in cost with increased loop complexity. Operator interface with the plant processes is through a cathode ray tube and keyboard. Potential annual savings for a 100 mgd plant are $400,000 for centralized control and $600,000 for computer control. From results of static and dynamic analyses, the dissolved oxygen control loop can save 38% through hydraulic load following when compared with constant-rate feed methods. In the chlorine loop, the hydraulic load following method can save 20% in annual Cl costs, and the total load following method, 80%. (Cassar-FRC)
W81-05339

SEWER TRUNK LINES CAN BE TREATMENT FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
M. Green, and G. Shelef.
Water and Sewage Works, Vol 127, No 8, p 26, 27, 52, 53, August, 1980. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Wastewater facilities, *Aeration, *Main sewers, Secondary wastewater, Secondary

wastewater treatment, *Wastewater treatment, Oxygenation, Air circulation, Oxidation, Sewers, *Sewer systems.

The possibility of using the long detention times characteristics of wastewater in urban sewer systems as treatment time is explored. The optimized system is based on a closed-loop-main design, aerated with air or oxygen and operated under high loading conditions except for a final section of the system that receives no loading in order to ensure a highly polished effluent. The biological sludge is settled and returned in a required amount to the origin of the system once it completes the cycle. Advantages of the system are listed. Experiments were performed using two different initial sludges: 10,000 mg volatile suspended solids (VSS) and 3,000 mg VSS. These initial VSSs gave final volatile suspended solids concentrations of 1,000 mg/liter and 500 mg/liter, respectively. The results of the study indicated that introducing sludge and air into the sewage conduits can give secondary effluent quality (removal efficiencies of 80% COD and 93% BOD). (Baker-FRC)
W81-05345

5E. Ultimate Disposal Of Wastes

FLOOD POTENTIAL OF TOPOPAH WASH AND TRIBUTARIES, EASTERN PART OF JACKASS FLATS, NEVADA TEST SITE, SOUTHERN NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W81-05017

CLOSURE OF HAZARDOUS WASTE SURFACE IMPOUNDMENTS,
Acurex Corp., Mountain View, CA. Energy and Environmental Div.
A. W. Wyss, H. K. Willard, R. M. Evans, R. J. Schmitt, and R. G. Sherman.
Environmental Protection Agency Report SW-873, September, 1980. 100 p, 9 Fig, 8 Tab, 124 Ref.

Descriptors: *Wastewater disposal, *Wastewater lagoons, *Stabilization ponds, *Settling basins, *Hazardous materials, *Groundwater pollution, Water pollution prevention, Leachates, Water pollution sources, Linings, Water pollution sources, Air pollution.

This manual describes and references the methods, tests, and procedures involved in closing a site in such a manner that minimizes the need for further maintenance, and controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to ground waters, surface waters, or the atmosphere. Surface impoundments are designed to hold liquid wastes and include holding, storage, settling, and aeration pits, ponds, and lagoons. They may be closed leaving the waste in place or after removal of the waste. The waste hazard potential, ground water availability and quality, soil zone, and proximity of water supplies must be determined so that a suitable containment system can be devised. The containment system may include a liner, a cover and leachate and gas collection equipment. Liners prevent movement of liquids into the groundwater, while covers prevent entry of water into the impoundment. Consolidation of the waste may result in surface subsidence with deleterious effects on the surface appearance and use, collections of water in depressions, or even fracture of the cover. Post-closure use of the site should be planned before selection of the cover and be restricted to those uses which maintain the integrity of the site, combined with regard for the natural conditions and the needs of the community. Technical criteria for closure procedures to protect air and water quality are presented. (Brambley-SRC)
W81-05027

LANDFILL AND SURFACE IMPOUNDMENT PERFORMANCE EVALUATION MANUAL,
GEOTECHNICS, Inc., Columbus, OH.
C. A. Moore.
Environmental Protection Agency Report SW-869, September, 1980. 69 p, 23 Fig, 27 Ref, 4 Append.

Descriptors: *Hazardous materials, *Waste disposal, *Land disposal, *Leachates, *Water pollution control, Groundwater pollution, Evaluation, Vertical flow, Horizontal flow, Design criteria, Mathematical equations.

This evaluation procedures manual has been developed to describe the technical approach and to present equations for determining how the design of hazardous waste surface impoundments and landfills will function in controlling the quantity of liquids released to the environment. The procedures should allow an evaluator to determine the adequacy of designs for: compacted clay or synthetic liners intended to impede the vertical flow of liquids; sand or gravel drainage layers intended to convey liquids laterally into collection systems; slopes on such liner systems; and spacings of collector drains. The placing of the liners, drainage layers, and waste can be diagrammed to obtain a liquid routing diagram. Evaluation of this diagram in terms of liquid transmission control and diversion interfaces is the first step in evaluating the proposed design. The principles governing horizontal and vertical flow through the layers are examined, and equations are developed to predict the relative proportions of each direction of flow. The evaluation procedures are assembled in a flow chart of the entire process. (Brambley-SRC)
W81-05028

GUIDE TO THE DISPOSAL OF CHEMICALLY STABILIZED AND SOLIDIFIED WASTE.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Environmental Protection Agency Report SW-872, September, 1980. 125 p, 6 Fig, 10 Tab, 56 Ref, 2 Append. EPA-IAG-D4-0569.

Descriptors: *Waste disposal, *Industrial wastes, *Waste management, *Hazardous materials, Chemical treatment, Stabilization, Solidification, Water pollution control, Groundwater pollution.

Stabilization/solidification of industrial waste is a pretreatment process that has been proposed to insure safe disposal of wastes containing harmful materials. This manual examines the regulatory considerations, current and proposed technology, testing procedures and design of landfills, and other options involved in disposal systems using stabilization/solidification of wastes. The treatments considered include: cement-based processes; pozzolanic processes; thermoplastic techniques; organic polymer processes; surface encapsulating techniques; self-cementing processes; and glassification and production of synthetic minerals or ceramics. The treatment for any particular waste will depend on the amount and character of the waste to be stabilized, the economics involved, and the properties of the disposal site. Stabilization processes generally increase density and strength, and decrease permeability of wastes, and aim to reduce leaching and biological attack. A listing of major suppliers of stabilization/solidification technology and a summary each process is included. (Brambley-SRC)
W81-05029

EFFECTS OF SLUDGE IRRIGATION ON THREE PACIFIC NORTHWEST FOREST SOILS,
Washington Univ., Seattle. Coll. of Forest Resources.
D. D. Wooldridge, and J. D. Stednick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204068, Price codes: Environmental Protection Agency Report EPA-600/2-80-002, March, 1980. 184 p, 24 Fig, 32 Tab, 24 Ref, 3 Append.

Descriptors: *Sludge disposal, *Forests, *Wastewater irrigation, *Soil chemistry, Groundwater, Leaching, Land disposal, Soil water, Forest soils, Viruses, Bacteria, Nitrogen, *Pacific Northwest, Impaired water use.

Forested regions offer an alternative for disposal of liquid wastes with the potential benefits of economical waste disposal and accelerated forest growth. Digested liquid municipal sludges contain biodegradable nutrients and sufficient water to enhance forest growth. A sprinkler irrigation system was developed for uniform applications of sewage sludge to forest plots. The effects of sludge irrigation were studied on the Everett, Mashel and Wilkeson soil series in and near Pack Demonstration Forest in Washington. The renovating capacity of forest soils for most suspended and dissolved constituents in sludge was very good (95 to 99%). Nitrogen was the exception as nitrification rates increased with increased rates of sludge applications, resulting in leaching of nitrate nitrogen and concomitant cation losses in soil water throughout the surface 2 m of soil. Leaching losses did not alter dissolved ions in groundwater at 10 m. Optimum loading rates of 20 to 30 mt/ha/hr of sludge show trends to increase surface soil total N, organic material and cation exchange capacity. Analyses for virus at all depths in the soil and from the soil solution at corresponding depths were negative, nor were human pathogens of the bacteria type isolated. Sludge applications increased the growth rate of treated trees. Water applied after sludge irrigation also may enhance tree growth over sludge only applications. (Moore-SRC)
W81-05051

HYDROLOGIC SIMULATION ON SOLID WASTE DISPOSAL SITES (HSSWDS),
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W81-05061

SUPERFUND PROPOSED TO CLEAN UP HAZARDOUS WASTE DISASTERS,
For primary bibliographic entry see Field 6E.
W81-05114

THE PREPARATION OF SEWAGE SLUDGES OF CONTROLLED METAL CONTENT FOR EXPERIMENTAL PURPOSES,
Water Research Center, Herts (England).
For primary bibliographic entry see Field 3C.
W81-05230

GEOTECHNICAL INVESTIGATIONS DURING DRILLING OF A DEEP DISPOSAL WELL IN DADE COUNTY, FLORIDA,
CH2M/Hill, Inc., Gainesville, FL.
U. P. Singh, and C. R. Sproul.
Groundwater, Vol 18, No 5, p 498-502, September-October, 1980. 3 Fig, 1 Ref.

Descriptors: *Disposal wells, *Injection wells, *Wastewater disposal, Well drilling, Aquifer testing, *Florida, Geologic formations, Geohydrology, Test wells, Deep wells, Transmissivity.

A 976 meter deep exploratory injection well drilled in south Dade County, Florida, indicated that deep underground injection of 50 million gallons per day of secondary treated wastewater was feasible. The freshwater Biscayne aquifer extended to 30 meters. Beyond that, the limestone, siltstone, and clay Hawthorne formation reached to 281 meters, the beginning of the partially fossiliferous limestone Floridian aquifer. Water from the Floridian is brackish (chlorides 700 mg per liter at the top to 15,000 mg per liter at the bottom, 512 meters). The strata between 512 meters and 851 meters are a non water-producing, confining bed. The Boulder zone, beginning at 851 meters, is very hard, fractured, cavernous, dark dolomite with water similar to sea water. Transmissivity is high, 170,000 sq meters per day. Estimated travel time from the top of the Boulder Zone to the bottom of the Floridian aquifer is 343 years. The injection zone is between 863 and 891 meters. (Cassar-FRC)
W81-05236

IRRADIATED DIGESTED SEWAGE SLUDGE: EFFECTS ON PLANT-SYMBIONT ASSOCIATIONS IN THE FIELD,

Massachusetts Univ., Amherst. Dept. of Plant Pathology.
R. A. Spitko, and W. J. Manning.
Environmental Pollution (Series A), Vol 25, No 1, p 1-8, 1981. 5 Tab, 27 Ref.

Descriptors: *Land disposal, *Sludge, Wastewater, Crops, Onions, Beans, Sludge digestion, *Plant growth, Heavy metals.

Results are reported of a two year field study on irradiated, digested municipal sludge on Rhizobium nodulation in bean and VA mycorrhizal infection in onion. Sludge used was anaerobically digested, liquid municipal sewage sludge from Boston's Deer Island Treatment Facility. Prior to land application it was disinfected with high energy electrons. Two weeks after sludge application, bush bean and onion were planted. Three plots were given a single sludge application at the rate of 4.7 metric tonnes/ha dried sludge. Three other plots received double this amount. Three more plots served as controls, receiving 111 kg/ha each of 10-10-10 N,P,K inorganic fertilizer. Sludge applications at both rates inhibited rhizobial nodulation of bush bean and VA mycorrhizal infection in onion. Heavy metal accumulation in soil and plant tissue, pH, soluble salt levels and N and P status of sludge and soil were monitored throughout the experiment. (Baker-FRC)
W81-05293

5F. Water Treatment and Quality Alteration

UTILIZATION OF NON-WOVEN FABRICS IN WATER TREATMENT,

L. M. Silva.
U.S. Patent No 4,222,877, 13 p, 22 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 1027, September 16, 1980.

Descriptors: *Patents, *Water treatment, *Filtration, *Filters, Water purification, Fabrics, Color removal, Turbidity removal, Non-woven fabrics.

A filtering method, and a filter, for removing turbidity and color from water, uses as a filtering medium, a blanket of non-woven fabric, particularly a blanket of felted fibers. The blanket is, in use, supported on a gravel bed, slotted ceramic blocks or the like, and can be held and protected by a grating. (Sinha-OEIS)
W81-05082

PROCESS AND AN INSTALLATION FOR THE TREATMENT OF WATER,

Eilandgebied Curacao, Willemstad (Netherlands Antilles). (Assignee).
R. L. Eisden.
U.S. Patent No 4,222,825, 5 p, 2 Fig, 10 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 1011, September 16, 1980.

Descriptors: *Patents, *Water treatment, *Desalination processes, *Water quality, Equipment, Distillation, Flash distillation, Gases, Carbon dioxide, Mixing.

A process and installation for the treatment of distillate water recovered by flash evaporation from impure water, such as sea water, in which gases desorbed during the flash evaporation, including carbon dioxide, are recovered and intermixed with the distillate water prior to and inside an absorber so that the carbon dioxide is absorbed by the distillate water. The water is thereby improved for human consumption. (Sinha-OEIS)
W81-05085

FLOCCULATION OF BRACKISH WATER FROM A TIDAL RIVER,

Louvain Univ. (Belgium). Inst. voor Industriele Scheikunde.
G. Alaerts, and A. Van Haute.
Water Research, Vol 15, No 5, p 517-523, May, 1981. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Flocculation, *Brackish water, *Tidal rivers, Rivers, *Water treatment, Iron chloride, Alum, Suspended solids, Coagulation, Water quality, Hydrogen ion concentration, Ions, Turbidity, Scheldt River, *Belgium.

Jar tests were used to find the optimum dose of flocculant to treat water from a tidal river, the River Scheldt, Belgium, 50 km from the North Sea. The unusual problem encountered was the wide variation in some water quality parameters, sometimes 10-fold within the 6-hour tidal periods. Daily variations for a typical day in April 1973 were suspended solids, 53.4 to 202 mg per liter; dissolved solids, 1329 to 4827 mg per liter; chloride, 446 to 2227 mg per liter; and phosphate, 1.59 to 6.27 mg per liter. A pH of 6 proved acceptable for flocculation with FeCl3 or alum. Suspended solids as measured by turbidity proved to be the most reproducible water quality parameter. Changes in ionic strength (800 to 16,120 micromho per cm) had a negligible effect on flocculation. Presettling was not necessary. The von Smoluchowski model was appropriate to describe the kinetics of this sweep coagulation. Water of 5 NTU was obtained with about 20 mg per liter iron salt or alum. The iron compound had better flocculating qualities than the alum. (Cassar-FRC)
W81-05160

A STORY OF SUCCESS,

Engineering Services, Inc., Springdale, AR.
J. W. Martin.
Southwest and Texas Water Works Journal, Vol 63, No 1, p 12-13, April, 1981. 1 Fig.

Descriptors: *Water supply development, *Surface water, *Reservoir yield, Surface water availability, Water treatment, Groundwater, *Gillham Lake, *Arkansas.

The success of the Gillham Lake Regional Water Association in an area in which development was limited by an inadequate water supply is described. In the past there were several outbreaks of hepatitis in the area that were related to contaminated water sources. These outbreaks led to the development of several small water systems using shallow wells 300 feet deep or less. Problems have included limited supply during dry weather and the fear of contamination of the wells. While groundwater is of poor quality and quantity in the area, surface water is abundant and of high quality. The small water systems joined to form the Gillham Lake Regional Water Association and used the Gillham reservoir, constructed for flood control and to provide recreation, for a water supply. The planned treatment plant for Gillham lake has a capacity of 1.25 million gallons per day, with provision to double capacity. Treatment will consist of flocculation, sedimentation, filtration, and disinfection. Water will be pumped from the storage tank to the various towns. (Small-FRC)
W81-05191

REHABILITATION OF STATE PARK WATER SYSTEM,

McGoodwin, Williams, and Yates, Inc., Fayetteville, AR.
O. T. Williams, Jr.
Southwest and Texas Water Works Journal, Vol 63, No 1, p 14, 16, April, 1981. 1 Fig.

Descriptors: *Rehabilitation, *Water supply, *Water conveyance, Water quality, Water treatment, Parks, Camp sites, Recreation demand, Devil's Den, *State parks, *Arkansas.

Rehabilitation of the potable water system for Devil's Den State Park, Arkansas, is described. Before rehabilitation, raw water was obtained from the Lee Creek and from a shallow (40 ft) well located near the channel of the creek. Water was treated through sedimentation, chemical treatment, and chlorination before being dispersed to the park headquarters, public rest rooms, and camping areas. A ground storage tank with a capacity of about 50,000 gal completed the system. Shortly after the system came into use, the pumping station on Lee creek received flood damage and was abandoned, and the raw water well caved in. A new 55 ft well was drilled which yielded water with low turbidity and high quality. The water was passed through the treatment plant because of the high use of the area which treatened water quality. The renovated system, including the raw water pumps, treatment facility, and high service pump system, is completely automatic. (Small-FRC)
W81-05192

POTASSIUM PERMANGANATE: AN ALTERNATIVE TO PRECHLORINATION,

Carus Chemical Co., La Salle, IL.
K. J. Ficek, and J. E. Boll.
Aqua, No 7, p 153-156, 1980. 7 Fig, 18 Ref.

Descriptors: *Chlorination, *Potassium permanganate, *Trihalomethanes, Manganese, Iron, Algae, Slime, Clams, Oxidation, Chlorinated hydrocarbons, Organic matter, Drinking water, *Water treatment, Odor control, Taste.

The National Interim Primary Drinking Water Regulations limit the concentration of trihalomethanes (THM) in drinking water to 0.10 mg per liter. As a result, potassium permanganate is being considered as an alternative to prechlorination in the water treatment process. It not only minimizes THM formation, but in doses of 0.25 to 4 mg per liter it controls taste and odor, algae, and slime, and eliminates Mn in the raw water. Although KMn04 has been used for over 20 years to control taste, odor, iron, Mn, and Asian clams, its use as a chlorine alternative to reduce THM is recent. Early studies on the use of KMn04 showed a 5-20% reduction in THM with doses of 0.7-5.0 mg per liter and subsequent chlorination. A 40% reduction was obtained under extreme oxidation conditions. Other tests revealed that the best sequence for treatment was permanganate oxidation, coagulation, then chlorination, before or after filtration. If the permanganate and chlorine are added simultaneously, THM concentration is increased over that resulting from C1 treatment alone. In 23 runs in a West Virginia Plant, prechlorination produced an average of 127 ppb THM; permanganate followed by C12, 56 ppb. (Cassar-FRC)
W81-05240

DESIGN OF AIR STRIPPING TOWERS TO REMOVE VOLATILE CONTAMINANTS FROM DRINKING WATER,

Montgomery (James M.) Inc., Pasadena, CA.
M. C. Kavanaugh, and R. R. Trussell.
Aqua, No 6, p 118-125, 1980. 7 Fig, 5 Tab, 19 Ref.

Descriptors: *Water purification, *Chlorinated hydrocarbons, *Packed towers, Organic compounds, Chloroform, Chlorination, Design criteria, Experimental design, *Water treatment, *Aeration, Mass transfer, Drinking water.

This paper presents a procedure for designing packed towers for removal of volatile organic water contaminants from water by aeration. The design assumes that contaminants obey Henry's Law, and at the low concentrations usually encountered in water, most organic contaminants satisfy this requirement. The packed tower has several advantages: low energy losses, easy maintenance, countercurrent operation, and low capital and operating costs. Information needed for the design includes packing physical constants, Henry's constants, and liquid-phase mass transfer coefficients as a function of temperature. The procedure is illustrated with a sample problem, reducing chloroform in a chlorinated water supply from 200 to 50 micrograms per liter. Calculations indicate a flowrate of 65.7 liters per sec would remove 75% of the chloroform at 20C using a 1.2 meter diameter tower, packed with 1.5 meters of 50 mm polypropylene Super Intalox packing. Estimated costs for a tower of 63.1 liters per sec capacity are $40,000. A comparable granular activated carbon column costs $600,000. (Cassar-FRC)
W81-05245

ACINETOBACTER SSP.: DISTINCT MORPHOLOGY ON EOSIN METHYLENE BLUE AGAR AS AN AID TO IDENTIFICATION IN DRINKING WATER,

Municipal Environmental Research Lab., Cincinnati, OH.

For primary bibliographic entry see Field 5A.
W81-05304

STERILISED WATER USING UV RADIATION,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
D. Kuse.
Water Services, Vol 84, No 1007, p 25-26, January, 1980. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Ultraviolet radiation, *Sterilization, *Light intensity, *Water treatment, Escherichia coli, Performance evaluation.

A water sterilization unit was developed which uses high intensity UV-C lamps and is designed for a water flow rate of 100 cu m/hr. Ultraviolet radiation is an appropriate procedure for water sterilization because it is simple, there are no environmental risks, and there is no impairment in the taste or odor of the water. The unit contains a lamp installed with its longitudinal axis perpendicular to the direction of flow in a straight pressure tube through which the water flows. The lamp is separated from the water by a quartz glass tube, and a photodetector monitors the radiation reaching the irradiation chamber. A monitoring system records both the UV emission of the lamp and also possible losses in intensity due to soiling of the glass. Experiments with the unit and unfiltered, artificially inoculated (E. coli) river water found a penetration depth at 254 nm of 15 cm. despite the low UV transmittance of the water and its high solids content, there was an E. coli destruction rate of at least 99.9% at a water flow rate of 100 cu m/hr. (Small-FRC)
W81-05315

DEVELOPMENT AND EVOLUTION ON THE CENTRAL CONTROL SYSTEM IN MARSEILLES' AREA WATER SUPPLY (EXPERIENCE ET EVOLUTION DU CONTROLE CENTRALISE DES INSTALLATIONS D'ALIMENTATION EN EAU DE L'AGGLOMERATION MARSEILLAISE),
Societe des Eaux de Marseille (France).
G. Ferrier.
Aqua, No 1, p 37-40, 1981. 4 Fig.

Descriptors: *Municipal water, *Water control, *Metropolitan water management, Control systems, Remote control, Water supply, *Marseilles, France, Performance evaluation.

The difficult conditions of the Marseilles area water supply necessitated the study and gradual implementation of a central control system. Most of the supply is obtained from the Durance via the Marseilles Canal, 100 km long and 130 years old. Supplementary water is now being added from the Provence Canal and by groundwater pumping. A completely automatic monitoring system could not be installed because of the age of the system and the necessity of avoiding service interruptions. A radio data transmission system was selected with telephone transmission as a backup. A network of 26 water quality and hydrographic monitoring stations was set up and has been operating satisfactorily for three years. Confidence of operators in the equipment has gradually increased. Maintenance costs have amounted to about 5% of the capital cost to date. The system was designed to permit possible expansion. (Carroll-FRC)
W81-05334

LOW COST TECHNOLOGY APPLIED TO WATER TREATMENT PLANTS (APPLICATION DES TECHNOLOGIES A FAIBLE COUT AUX STATIONS DE TRAITEMENT D'EAU POTABLE),
For primary bibliographic entry see Field 6A.
W81-05335

THE NEW TREATMENT PROCESS AT MERSUR-OISE NEAR PARIS: THE CHOICE ADOPTED FOR THE MODERNISATION OF THE WORKS (LA NOUVELLE FILIERE DE TRAITEMENT DE L'USINE DE MERY-SUR-OISE PRES DE PARIS: LES CHOIX ADOPTES POUR LA MODERNISATION DE L'USINE),
J-C. Nastorg.
Aqua, No 6, p 8-12, 1980. 9 Fig.

Descriptors: *Reservoirs, *Ozonation, *Activated carbon, *Water treatment facilities, Mery-sur-Oise, France, Water pollution, Control systems, Water storage.

The water treatment plant at Mery-sur-Oise near Paris was modernized to adapt to the fluctuating water quality of the Oise River, which is severely polluted on occasion. Added to the existing process are pretreatment of raw water with ozone, storage in a 400,000 cu meter capacity reservoir, and filtration through activated carbon. The reservoir storage enhances raw water quality and serves as a reserve in case of heavy pollution in the river. During these alterations automated instrumentation was decentralized into three autonomous but connected clusters. A large, industrial-scale computer is located in the central control room. (Cassar-FRC)
W81-05338

WATER RELATED DISEASES AND THE BROAD PRINCIPLES OF WATER TREATMENT APPLICABLE TO THE THIRD WORLD,
E. Windle-Taylor.
Aqua, No 2, p 33-34, 1980. 3 Tab, 8 Ref.

Descriptors: *Public health, *Human diseases, *Pathogens, Water distribution, Water supply development, *Water treatment, Diseases, Infection, Epidemics, *Developing countries.

Some improvement in health conditions has resulted from providing safe drinking water supplies in developing countries. However, without proper sanitation and personal and domestic hygiene, water treatment programs are not fully effective. Rural areas should use groundwater as a supply source, treating with the chlorine pot if necessary. If surface water is used, sand filtration, with or without preliminary sedimentation, followed by disinfection can produce a potable supply. Urban areas can often use electric power for water treatment in addition to the methods suitable for rural areas. Package water plants are also available for tropical countries. (Cassar-FRC)
W81-05340

SAUDI ARABIA: HAIL WATER SUPPLY SCHEME.
Aqua, No 7, p 19, 1980.

Descriptors: *Water conveyance, *Water supply development, *Pumping plants, Groundwater, Hail, *Saudi Arabia, Water distribution, Reservoirs.

The water supply of Hail, Saudi Arabia, is being expanded by tapping an aquifer 45 km to the north of the town. This water, which does not require treatment, is pumped via ductile iron pipeline to a reservoir on the outskirts of the town. All pumping and storage equipment is designed for easy maintenance and operation. Electrical power is provided by six diesel generators. The present water transmission is 20,000 cu meters per day, with provisions for double the capacity in the future. (Cassar-FRC)
W81-05341

PUBLIC WATER SUPPLY AND THE RIVER RHINE. 10 YEARS INTERNATIONAL ASSOCIATION OF WATERWORKS IN THE RHINE CATCHMENT AREA (IAWR),
International Association of Waterworks in the Rhine Catchment Area, Amsterdam (Netherlands).
L. J. Huizenga.
Aqua, No 6, p 27-32, 1980. 7 Fig, 4 Tab.

Descriptors: *Water quality, *Rhine River, *Pollution load, Water pollution control, Metals, Oxygen, *Water treatment, Drinking water, Chlorides, Rivers, Salt Convention, Chemical wastes.

The 1960 accidental discharge of the insecticide endosulfan into the Rhine River at Frankfurt/Main was one of the factors promoting formation of the International Association of Waterworks in the Rhine Catchment Area (IAWR) in January, 1970. The organization consists of three subsidiary groups representing 85 waterworks in five countries serving 20 million people and many industries. A high priority objective of the organization is to reduce the serious pollution in the Rhine. A table lists several water quality parameters as determined in 1948, 1969, and 1979. At present the BOD level is not acutely disturbing, but chloride, naturally 20 mg per liter, is unacceptably high at 167 mg per liter (maximum measured, 354 mg per liter in the dry year, 1976). Nitrates continue to increase, and phosphates have leveled off at about 1.20 mg per liter. Metals and biocides concentrations have improved since 1972, but toxic organic micropollutants are still a serious problem. Several corrective agreements are in different stages of implementation. The Salt Convention, which aims at reducing salt discharges from French territory, mostly potash mines, has not been approved by France. A 1976 treaty, operative February 1979, is designed to stop discharge of selected dangerous substances. Only the mercury standard has been drawn up and will be effective in July 1983. (Cassar-FRC)
W81-05342

START-UP OF THE WATER TREATMENT PLANT AT VAL THORENS THE HIGHEST WATER TREATMENT PLANT IN EUROPE.
Aqua, No 3, p 9-10, 1980.

Descriptors: *Water treatment facilities, *Snowmelt, Turbidity, *Val Thorens, Water quality, Water supply, Drinking water, Ski resort, Mountains, Europe.

A new water treatment plant at Val Thorens is the highest in Europe (2400 meters). It converts melting snow into clear drinking water for this ski area town. Between June and September, only a slight disinfection is necessary for the abundant, clear spring water supply. The winter frost, penetrating to 1.5 meters, dries up these springs, and surface water becomes scarce. The 850 cu meter per day plant is equipped to treat the two major winter problems: turbidity from glacial dust in snowmelt and increased human pollution in winter. (Cassar-FRC)
W81-05348

THE PIPES OF AL'AIN.
Aqua, No 1, p 10, 12, 14, 1980.

Descriptors: *Water reuse, *Water distribution, *Water supply development, Water treatment facilities, Wastewater treatment facilities, Oman, Al'Ain, Irrigation, Reservoirs, Desalination.

Al'Ain, an oasis in Oman, has developed from a town of 10,000 in 1965 to a city of 80,000 in 15 years. An adequate water supply, funded by oil money, was responsible for this rapid development. Feasibility studies in 1974 marked the beginning of a no-waste water system, in which sewage effluent is used for irrigation. The original water tanker delivery system was maintained during construction, which included eight reinforced concrete reservoirs with pumping stations, water mains to feed ground tanks, and connections from ground tanks to roof tanks with polyethylene piping. A sewage treatment plant, based on extended aeration, was built to produce a tertiary effluent suitable for irrigation. (Cassar-FRC)
W81-05349

5G. Water Quality Control

DISCHARGE OF SALTWATER FROM PERMIAN ROCKS TO MAJOR STREAM-AQUIFER SYSTEMS IN CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. Gogel.
Kansas Geological Survey, Lawrence, Chemical Quality Series 9, 1981. 60 p, 9 Fig, 4 Plates, 5 Tab, 22 Ref.

Descriptors: *Saline water intrusion, *Aquifers, *Water pollution sources, *Aquifer characteristics,

*Water quality, Geohydrology, Groundwater movement, Water level, Observation wells, Encroachment, Contamination, Saline-freshwater interfaces, Computer models, Regression analysis, Chemical analysis, South-central Kansas, *Kansas.

Saltwater inflow from Permian rocks has degraded freshwater systems in central and south-central Kansas. Leakage of freshwater from unconsolidated deposits has caused solution and collapse of salt and gypsum beds in the Wellington Formation. This zone of fractures and solution cavities containing saltwater is termed the Wellington aquifer. A ground-water divide is indicated on the potentiometric surface of the aquifer near Hutchinson where flow is northward toward the Smoky Hill River valley or southeastward toward the Arkansas River valley. The increase in saltwater discharge and chloride load to the Arkansas River between Derby and Arkansas City is about 0.60 cubic foot per second and 229 tons per day, respectively. In several areas where the potentiometric surface of the Wellington aquifer is above the water table of the unconsolidated deposits, the difference in head may cause upward leakage of saltwater. Contamination also may occur near Hutchinson where erosion of intervening shale layers could provide a hydraulic connection between saltwater and freshwater aquifers. Methods of alleviating saline-water intrusion include desalinization, injection into deep mineralized aquifers, evaporation from surface ponds, or by collection and dilution with freshwater in streams during high flows. (USGS)
W81-05023

QUARTERLY PROGRESS REPORT; NATIONWIDE URBAN RUNOFF PROGRAM,
Environmental Protection Agency, Washington, DC. Water Planning Div.
Report, July, 1980. 96 p, 28 Fig.

Descriptors: *Urban runoff, *Storm runoff, *Water pollution sources, Monitoring, Administration, Pollutants, Environmental effects, Pollution load, Water pollution control, Water quality management.

This report indicates the status of 29 Nationwide Urban Runoff Program (NURP) projects. Most projects are working towards the implementation stage, although some are in this phase, monitoring and sampling storm events. Each project is summarized, giving administrative information, with information on grantee, budget, grant amount and status. The type of receiving water is noted, its beneficial uses, the suspected pollutants and the impact of these pollutants. The best management practice in some cases have been decided, but many have not. Each project location is described briefly, identifying the causes of the problems, and giving the objectives of the NURP program. Most objectives focus on the need to identify and quantify the pollutant loads, evaluate possible controls, and implement the most cost effective management programs. Each summary concludes with the project's status and findings to date, and any problems that have arisen. (Brambley-SRC)
W81-05025

CLOSURE OF HAZARDOUS WASTE SURFACE IMPOUNDMENTS,
Acurex Corp., Mountain View, CA. Energy and Environmental Div.
For primary bibliographic entry see Field 5E.
W81-05027

LANDFILL AND SURFACE IMPOUNDMENT PERFORMANCE EVALUATION MANUAL,
GEOTECHNICS, Inc., Columbus, OH.
For primary bibliographic entry see Field 5E.
W81-05028

THE DILUTION/FLUSHING TECHNIQUE IN LAKE RESTORATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-206054, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-016, April, 1981. 18 p, 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake restoration, *Eutrophic lakes, *Green Lake, *Moses Lake, *Flushing, Nutrients, Phosphorus, Chlorophyll, Transparency, Water quality control, Water transport, Costs, *Washington.

Dilution/flushing has been documented as an effective restoration technique for Moses and Green Lakes in Washington State. The dilution water added in both lakes was low in nitrogen and phosphorus content relative to the lake or normal input water. Consequently, lake nutrient content dropped predictably. Dilution or flushing rates were about ten times normal during the spring-summer periods in Moses Lake and three times normal on an annual basis in Green Lake. Improvement in quality (nutrients, algae, and transparency) was on the order of 50% in Moses Lake and even greater in Green Lake. The treatment of Green Lake started in 1962 and after 5 years the summer Secchi visibility had changed from 1 to 4 m, chlorophyll a from about 45 to 3 microgram/l, and total p from about 54 to 20 microgram/l. The treatment has continued to the present. Over a 1 year period in Moses Lake the Secchi visibility had changed from 0.9 to 1.5 m, chlorophyll a from about 45 to 21 microgram/l, and total p from about 150 to 86 microgram/l. The facilities for supplying dilution water were largely in place for the cited lakes; thus, costs for water transport were minimal. Available facilities, and therefore costs, for water transport would usually vary greatly, however. Achieving maximum benefit from the technique may be more limited by availability of low nutrient water rather than facilities costs. Quality improvement may occur from physical effects of washout and instability if only high nutrient water is available. (Brambley-SRC)
W81-05054

EVALUATION OF AERATION/CIRCULATION AS A LAKE RESTORATION TECHNIQUE,
Tetra Tech, Inc., Bellevue, WA.
R. A. Pastorok, T. C. Ginn, and M. W. Lorenzen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-191884, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-014, February, 1981. 64 p, 3 Fig, 6 Tab, 150 Ref.

Descriptors: *Lake restoration, *Literature review, *Water circulation, *Aeration, *Eutrophic lakes, Water quality, Thermal stratification, Cost analysis, Anaerobic conditions, Algal control, Recreation, Species diversity, Benthic fauna, Environmental effects.

Artificial aeration or circulation of lakes is commonly used for managing the ecological consequences of eutrophication. Water quality is enhanced by removal of thermal stratification and by oxygenation of the hypolimnion. This review of the literature indicates that artificial circulation and hypolimnetic aeration are cost-effective restoration techniques which can solve a variety of problems arising from anoxia in the hypolimnion of a eutrophic lake. The major benefits are enhancement of water quality for consumptive uses, control of algal blooms, improvement of recreational fisheries, and an increase in distribution and abundance of benthic macroinvertebrates. Adverse effects may include slowing of sedimentation, a temporary rise in blue-green algae, increase in growth of macrophytes, altered nitrogen and oxygen levels to levels hazardous for fish, and elimination of cold habitats in some lakes. These problems are less likely if the following technical aspects are addressed: correct placement of air release, neither oversizing nor undersizing the system, destratification speed that does not lead to oxygen depletion throughout the lake, suitable discharge velocity to avoid unintentional thermal destratification. (Brambley-SRC)
W81-05056

PRECIPITATION AND INACTIVATION OF PHOSPHORUS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke, and R. H. Kennedy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-196511. Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-012, February, 1981. 47 p, 9 Fig, 7 Tab, 66 Ref.

Descriptors: *Lake restoration, *Eutrophic lakes, *Chemical precipitation, *Phosphorus removal, Aluminum compounds, Zooplankton, Macrophytes, Environmental effects, Water pollution control, Sedimentation, Nutrients, Diversion.

Treatment of eutrophic lakes with aluminum sulfate and/or sodium aluminate is a successful method for removing phosphorus from the water column and for controlling its release from sediments. Twenty-eight lake projects treated with aluminum salts are reviewed and summarized. The technique is successful when sufficient doses of aluminum are applied, however a few undesirable side-effects such as reduced planktonic microcrustacea species diversity and increases in rooted plant biomass may occur. Methods to determine aluminum sulfate doses may emphasize short-term reduction in water column phosphorus or the long-term control of sediment phosphorus release while assuring maximum removal of water column phosphorus at the time of treatment. Maximum dose, dictated by the buffering capacity of the particular lake, is defined as that dose which reduces pH to 6, a pH favorable for forming insoluble aluminum hydroxide and for assuring that dissolved aluminum remains below potentially toxic concentrations. Lake dosage can be easily determined prior to application by titrating several lake water samples of varing alkalinity with aluminum sulfate, determining maximum dose for each sample, and establishing a relationship between alkalinity and maximum dose. Unit costs for treatment have not been established but for five studies giving information 10.8 + or - 4.83 man-days/metric ton were required for actual application. This lake restoration technique is successful and long-lasting when properly applied. It could become a standard means of treating small lakes or ponds following nutrient diversion. (Brambley-SRC)
W81-05057

SEDIMENT REMOVAL AS A LAKE RESTORATION TECHNIQUE,
Corvallis Environmental Research Lab., OR. Freshwater Div.
S. A. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-196503 Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-013, February, 1981. 59 p, 7 Fig, 2 Tab, 121 Ref, 1 Append.

Descriptors: *Lake restoration, *Lake sediments, *Dredging, Aquatic plants, Water pollution control, Eutrophication, Rehabilitation, Nutrients, Phosphorus removal.

Where lake improvement goals cannot be met by watershed nonpoint source pollutant controls alone, sediment removal may be necessary. The effectiveness and longevity of sediment removal is considered in terms of retarding eutrophication and reducing the impacts of toxic sediments. Freshwater lake sediment removal is usually undertaken to deepen a lake thereby increasing its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. Review of more than 60 projects and examination of 5 case histories reveals that the first three objectives are usually met through sediment removal. The effectiveness of dredging to control aquatic plants has not been well documented. Advantages of sediment removal techniques include ability to selectively deepen part of a lake basin, increase the lake volume, recover organically rich sediment for soil enrichment, and improve

limnetic lake quality. Disadvantages include high cost, phosphorus release from sediment, increased phytoplankton productivity, noise, lake drawdown, temporary reduction in benthic fish food organisms, the potential for release of toxic materials to the overlying water and for environmental degradation at the dredged material disposal site. High quality dredge material can be used for beneficial purposes and may offset the initial high cost of dredging. The technique is recommended for deepening and for reducing phosphorus release from sediment. (Moore-SRC)
W81-05058

CLEAN LAKES PROGRAM STRATEGY.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 2H.
W81-05059

THE ECONOMIC ANALYSIS OF HEALTH RISKS AND THE ENVIRONMENTAL ASSESSMENT OF REVISED FECAL COLIFORM EFFLUENT AND WATER QUALITY STANDARDS, R77-12.
Huff and Huff, Inc., LaGrange, IL.
For primary bibliographic entry see Field 6B.
W81-05069

APPARATUS FOR COLLECTING LIQUIDS AND/OR SLIMES FLOATING ON LIQUID SURFACES.
G. Ayroldi.
U.S. Patent No 4,224,162, 8 p, 5 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P1456-1457, September 23, 1980.

Descriptors: *Patents, *Water pollution, *Water quality control, Oil pollution, Slim, Mechanical equipment, Floating, Skimming, *Separation techniques.

An apparatus is described for separating and removing, exclusively by mechanical means, a polluting liquid or slimes floating on water or another liquid not miscible with the polluting substance. It comprises a flexible floating platform of a specific gravity less than that of the water. At the center of the platform is mounted a suction device provided with at least a lower suction pipe. The platform has channels with entrance orifices arranged on its periphery and is provided with a weir sill. Each suction pipe is connected, through a flexible pipe, to a pumping unit mounted on a remote fixed or floating support means. (Sinha-OEIS)
W81-05071

SURFACE ACTIVE COMPOSITIONS AND METHOD OF USE IN DISPERSING OR COLLECTING OIL SLICK.
Labofina Societe Anonyme, Brussels (Belgium). (Assignee).
A. O. Lepain.
U.S. Patent No 4,224,152, 5 p, 5 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 998, No 4, P 1453, September 23, 1980.

Descriptors: *Patents, *Oil pollution, *Water quality control, Dispersion, Chemical reactions, Oil spills, Oil slicks, Surface-active composition.

Objects of the invention are to: provide a surface-active polyvalent composition which not only is particularly efficient as an oil collecting composition, but also as a protective composition for the beaches. The mixture of surface-active compounds includes at least one solid surface-active compound and at least one liquid surface-active compound and a mixture of solvents comprising a glycol ether and at least one n-paraffin having from about 10 to 16 carbon atoms. The method for dispersing or collecting an oil slick on water comprises the step of applying the composition to the surface of the water. Applying the composition to the beach acts as a barrier against damage from an oil slick. (Sinha-OEIS)
W81-05075

UTILIZATION OF NON-WOVEN FABRICS IN WATER TREATMENT.
For primary bibliographic entry see Field 5F.
W81-05082

ULTRASONIC OIL SPILL REMOVAL.
A. Kuris.
U.S. Patent No 4,222,868, 8 p, 2 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 998, No 3, p 1023-1024, September 16, 1980.

Descriptors: *Patents, *Water quality control, *Oil spills, *Oil pollution, Water pollution treatment, Ultrasonics, Dispersion, Homogeneity, Oil-water interfaces, Oil slicks.

Oil slicks are dispersed by applying ultrasonic energy in a manner to produce periodic perturbations of large displacement amplitude in the fluid medium. A device for viscosity reduction of the oil into the body of water is obtained using an output radiator or ultrasonic motor for generating longitudinal vibrations of large displacement amplitude adapted to produce periodic perturbations in the oil. Reflecting means disposable in facing relation to the generating means output radiator may also be used. The oil to be dispersed is funneled through the gap between the ultrasonic motor and reflecting means. Accordingly there is an homogenizing of the oil and water at the interface so as to reduce the resulting mixtures viscosity for absorption into the body of water. By continuing the application of te vibratory energy the identity of the oil slick can be sufficiently lost so that it is totally dispersed into the body of water. (Sinha-OEIS)
W81-05083

LAKE MICHIGAN DIVERSION FOR WATER QUALITY CONTROL.
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. W. Male, and K. Soliman.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 121-137, March, 1981. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Diversion, *Water quality control, *Lake Michigan, Flow control, Navigation, Recreation, Water pollution control, Canals, Flood control, Optimization, Dissolved oxygen, Regulations, Instream aeration, Aeration.

A mathematical programming procedure is presented for determining the minimum amount of water which must be diverted from Lake Michigan to maintain water quality (dissolved oxygen standards) in the Chicago River and Canal system. Water is discharged into these systems for purposes of navigation, flood control, and water quality management. This optimization procedure uses an efficient network algorithm and determines average monthly diversion rates at each of the three control points. It was concluded that a yearly average direct diversion of 21.8 to 28.6 cu meters per sec (7.2 meters per sec for locking and leakage, 14.6-21.5 cu meters for discretionary discharge) is necessary to maintain the dissolved oxygen standard of the Illinois Water Pollution Regulations. Completion of 10 proposed instream aeration stations will allow a reduction of 9-15 cu meters per sec in discretionary discharge. Tables for minimum diversion for each month in the year at the three locations are presented bot for existing conditions and for conditions using aeration. The months of May through October require the highest percentages of direct diversion. (Cassar-FRC)
W81-05104

WATER QUALITY MANAGEMENT OF SKUDAI RIVER.
Singapore Univ. Dept. of Civil Engineering.
K. K. Chin, and T. N. Goh.
Water Resources Bulletin, Vol 17, No 2, p 203-208, April, 1981. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Water quality, Management, *Skudai River, *Malaysia, Urban runoff, Runoff, Urbanization, Industrial waste, Municipal wastes, Model studies, Costs, Economic aspects.

The purpose of this study was to assess the effect of rural and urban waste discharges on the water quality of the Skudai River, located at the Southern tip of Johore, Malaysia. The river discharges into the Johore Strait and has a drainage area of about 31,500 hectares. The basin has undergone extensive development for rubber and palm oil, with only around 775 hectares of the original rain forest remaining. The Skudai River is becoming increasingly polluted as a result of industrial and urban waste discharges and rural surface water runoff. To have a realistic pollution abatement program, a systems approach involving complete analysis of water quality models and environmental control procedures with consideration of various water use patterns, water quality criteria, and waste input is essential. A study is described in which some values are given for the treatment costs involved. The study may serve as an example of possible water management studies in other developing regions where problems have not yet been recognized or where assessment and solution have not year been attempted. (Baker-FRC)
W81-05170

PUBLIC WATER SUPPLY AND THE RIVER RHINE. 10 YEARS INTERNATIONAL ASSOCIATION OF WATERWORKS IN THE RHINE CATCHMENT AREA (IAWR).
International Association of Waterworks in the Rhine Catchment Area, Amsterdam (Netherlands).
For primary bibliographic entry see Field 5F.
W81-05342

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

HYDROLOGIC RECONNAISSANCE NEAR FOURTH OF JULY CREEK, SEWARD, ALASKA.
Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-223752, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-21, 1981. 10 p, 4 Fig, 2 Tab, 2 Ref.

Descriptors: *Planning, *Regional development, *Water supply, Groundwater, Surface water, Water quality, Streamflow, Flow characteristics, Aquifers, Groundwater movement, Recharge, Wells, Water analysis, Pollutants, *Alaska, Seward, Kenai Penninsula.

The 1.3-square-mile alluvial fan of Fourth of July Creek, Seward, Alaska, is being developed as an industrial area and port. Fourth of July Creek is a glacier-fed stream that occupies a braided channel near the middle of the fan. The presence of glacial flow during the summer and low discharge during the winter make streamflow a poor source of water for municipal and industrial use. Water infiltrates the fan from streams and precipitation and recharges an unconfined alluvial aquifer. Average recharge is 40-50 cubic feet per second, and ground water flows toward the coast where it discharges in springs and a 0.3-mile gaining reach of the creek. Properties and concentrations of all measured chemical constituents of water samples from two wells were less than the maximum amounts recommended for drinking water. Both the aquifer and the overlying unsaturated materials are coarse grained. The coarse-grained materials are poor filters and make the aquifer susceptible to pollution by contaminants disposed of or spilled on the alluvial fan. Avalanches may block the creek and cause flooding by directing streamflow into new or abandoned channels. (USGS)
W81-05012

FLUSHING STUDY OF SOUTH BEACH MARINA, OREGON.
Corvallis Environmental Research Lab., OR.
R. J. Callaway.

Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW2, p 47-58, May, 1981. 7 Fig, 23 Ref.

Descriptors: *Marinas, *Flushing, *Water circulation, Hydraulic models, Mathematical models, Tidal effects, South Beach Marina, *Oregon, *Water quality management.

Water quality impacts related to marina flushing efficiency and circulation were investigated in a study of the South Beach Marina, Oregon. South Beach Marina has a single entrance with free exchange with the main navigation channel where large currents develop during tidal changes. Flushing efficiency near the entrance was about twice as great as in the inner harbor when determined by field tests or estimated by hydraulic and mathematical models. Hydraulic and mathematical models did not successfully reproduce early flushing events. The first flood decrease was underestimated by 30-40% by both types of models. Both model results were too conservative in terms of pollutant concentrations. The hydraulic model studies successfully predicted that the marina would have satisfactory exchange because of the strong currents moving past the entrance. Hydraulic model studies of marinas this size may not be necessary if conservative predictions are acceptable. For marinas with single entrances, good approximations of flushing efficiency can be quickly made using simple box-model assumptions. (Small-FRC)
W81-05096

IMPROVED HOURLY RESERVOIR OPERATION MODEL,
California Univ., Los Angeles. School of Engineering and Applied Science.
L. Becker, and W. W-G. Yeh.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 283-287, March, 1981. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Hydroelectric plants, *Reservoir operation, Powerplants, Optimization, Central Valley Project, *California, Hydraulic systems, Computer programs.

The Incremental Dynamic Program with Successive Approximations (IDPSA) procedure was used to optimize reservoir operation at the Central Valley Project, California. Using less computer time than other systems, it decomposes a system into a number of subsystems and optimizes each in serial fashion. Releases close to zero are rejected because little power is generated at low flows. Hourly power demand requirements are eliminated from the set of constraints. An initial feasible policy may be fabricated with a minimum of multiple startups and shutdowns of generating units. (Cassar-FRC)
W81-05097

RISK AVOIDANCE OBJECTIVE IN WATER RESOURCES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
A. M. Nazar, W. A. Hall, and M. L. Albertson.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 201-209, March, 1981. 2 Fig, 5 Ref.

Descriptors: *Management planning, *Risks, *Water resources development, Irrigation, Planning, Multipurpose projects, Hydroelectric power.

In the past, rish has been implicitly considered by defining the design yield of a project with a given storage capacity as the largest yield that could have been obtained with no failure if the past historical record of streamflows were to repeat itself. In this method, risk was implicitly used as a constraint without any actual evaluation of the corresponding level of risk. This paper develops a method to define indices of risk to be explicitly included in analysis of water resource systems providing water for regional irrigation and electric power generation requirements. (Cassar-FRC)
W81-05105

INTEGRATED RIVER BASIN PLANNING IN A HOLISTIC UNIVERSE,
Michigan Univ., Ann Arbor.
G. Schramm,.
Natural Resources Journal, Vol 20, No 4, p 787-806, October, 1980. 2 Fig, 1 Tab, 48 Ref.

Descriptors: *River basins, *Regional planning, Regional development, Long-term planning, Environmental effects, Economic aspects, Social aspects, Political aspects, *River basin development.

River basin development should not proceed without examination of the major interrelated factors by which development goals and objectives are achieved, including environmental aspects. the costs of including environmental considerations in the planning process are modest compared with the potential price of environmental neglect. Integrated planning considers all potential benefits and all potential costs that may result from proposed actions or nonactions. The planning process should comprise a continuous exchange of ideas and problem formulation, maintaining close contact with public bodies, beneficiaries, and other impacted groups. Planning for the development of river basins involves both spatial and temporal dimensions. Spatial dimensions are related to both human-social-economic relationships and geographic features. Temporal dimensions may extend over lengthy periods of time, sometimes decades long, during which negotiations proceed, deadlocks between competing interests must be resolved, and changes occur in technology, human activity, and developmental goals. Planners must be flexible in their responses to the multiple goals and objects expressed by sub-regions, population sub-groups, and societal sectors. Resource and information limitations can be expected to pose problems for many planning efforts. If projects and programs are to be successful in achieving planned benefits and meeting objectives, the planning process must include preparation for implementation and for future continuity and operational viability. (Carroll-FRC)
W81-05112

AN INTERACTIVE COMPUTERIZED AID FOR THE DESIGN OF BRANCHING IRRIGATING NETWORKS.
Technion-Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W81-05122

BENEFIT-COST ANALYSIS AND DECISION-MAKING: AN EXTENSION.
DePaul Univ., Chicago, IL. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W81-05179

SYSTEM SOLUTIONS TO URBAN WASTEWATER CONTROL,
British Columbia Univ., Vancouver. Div. of Policy Analysis.
P. N. Nemetz.
Journal of Environmental Economics and Management, Vol 7, No 2, p 108-122, June, 1980. 1 Fig, 6 Tab, 19 Ref.

Descriptors: *Systems analysis, *Wastewater treatment, Urban planning, Planning, British Columbia, Municipal wastewater, Industrial wastewater, Alternative planning, Water pollution control, Pollution abatement, Pretreatment of water.

A least cost treatment system for wastewater effluents should be chosen from alternatives including not only the municipal treatment systems, but also redistribution of waste treatment among industrial dischargers. This is demonstrated with a community in British Columbia consisting of 4000 people, a brewery, a sawmill, 115 hotel-motel rooms, a 50-bed hospital, and about 40 small commercial establishments. Total sewage flow is 720,000 imperial gal per day. Systems analysis of 19 alternatives indicates that the responsibility for wastewater treatment should be divided between the town and its principal discharger, the brewery. Each urban area is unique, and application of systems analysis will produce a stronger or weaker argument for industrial pretreatment for each case. (Cassar-FRC)
W81-05307

A MICRO-HYDROLOGY COMPUTATION ORDERING ALGORITHM,
Canterbury Univ., Christchurch (New Zealand). Dept. of Engineering.
T. E. Croley, II.
Journal of Hydrology, Vol 48, No 3/4, p 221-236, November, 1980. 7 Fig, 2 Tab, 23 Ref.

Descriptors: *Algorithms, *Watersheds, *Hydrologic models, Mathematical studies, Computers.

Discrete-distributed-parameter models are essential for watershed modelling where practical consideration of spatial variations in watershed properties and inputs is desired. Lumped-parameter (microhydrology) models are applied to sub-areas which each possess essentially spatially-uniform properties. The outputs from these models are then combined through the use of a computation ordering technique. The development of a programmable algorithm for ordering these micro-hydrology computations is discussed. This algorithm permits automatic ordering within the computer of manually assigned nodes, node numbers, and node codes. The node definition, numbering, and coding schemes and the ordering algorithm are detailed with logic flow charts. Application of the algorithm within the context of a kinematic cascade model is demonstrated for the purpose of illustration only. Use of the algorithm avoids the forethought, tedium, and errors of manual-ordering techniques and results in smaller storage requirements in some cases. The algorithm may be extended to complicated geometries by defining more than one node at a given point. It is especially beneficial for use in several watersheds or in changes of resolution within a watershed. The node definition, numbering, and coding schemes are programmable for interactive use or for fully automated use. (Carroll-FRC)
W81-05309

RIVER BASIN HYDRO-SALINITY-ECONOMIC MODELING,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
H. O. Fapohunda, and R. W. Hill.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR1, p 53-69, March, 1981. 4 Fig, 5 Tab, 9 Ref.

Descriptors: *Salinity, *Crop production, *Economic evaluation, Crop yield, Drought, Water use, Water resources, Irrigation, *Model studies, Water demand, Mathematical models, River basins, Phreatophytes, *Watershed management, Water quality, Planning, Seasonal variation, Hadejia River Basin, Nigeria.

The effects of sequential water use in irrigation were modeled by combining an existing hydrologic/salinity model with a crop yield/economic simulation model. This model developed use functions that relate seasonal crop evapotranspiration and soil solution salt concentrations to yields. Application to the Hadejia River Basin, Nigeria, indicated that increasing shortages and salinity buildup produced net returns per unit area lower than in calibration runs. Reducing areas occupied by phreatophytes and open water in water supply, as well as salinity buildup, and decline of net profits. (Cassar-FRC)
W81-05310

ALTA: A CLASSIC CONFRONTATION,
For primary bibliographic entry see Field 6E.
W81-05326

NEW ZEALAND'S WAITAKI: A PLANNING PERSPECTIVE FOR REGIONAL RESOURCES,
Lincoln Coll. (New Zealand).
K. F. O'Connor, and K. A. Ackley.
Ambio, Vol 10, No 2/3, p 142-147, 1981. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Resources management, Water management, Planning, Resources development, *Water resources development, Comprehensive planning, Regional development, *New Zealand, Waitaki.

The area called Waitaki in New Zealand was chosen for the study of both nature and culture. The area includes both upland and lowland terrain, since the cultural disturbance of the landscape which characterized European colonization of the lowlands is now being reenacted in the uplands by descendants of the colonists. This area has been studied for aspects of biological and hydrological research as well as socioeconomic studies, often with historical and geographic dimensions. Future plans to use the Lower Waitaki River for generating electricity and for irrigation threatens the present habitat of more than 20 species of birds, as well as salmon and trout fisheries of considerable recreational significance and commercial potential. Multiobjective planning is needed in this area in which thorough consultation will be conducted with local and regional communities of interest, involving residents and recreational visitors as well as representatives of national interests. (Baker-FRC)
W81-05327

STEADY STATE NETWORKS ANALYSIS WITH SPECIFIED HEAD-DISCHARGES RELATIONSHIPS AT OUTLET NODES (ANALYSE DU REGIME PERMANENT DANS UN RESEAU DE DISTRIBUTION AVEC FIXES RELATIONS CHARGES-DEBITS AUX POINTS DE CONSOMMATION),
Calabria Univ., Cosenza (Italy).
F. Calomino, and P. Veltri.
Aqua, No 7, p 145-149, 1980. 5 Fig, 13 Ref.

Descriptors: *Network design, *Water supply systems, Piezometric head, Algorithms, Mathematical studies, Discharge capacity, Literature review, Steady flow.

Literature on methods for checking a water supply network with specified discharge rates is reviewed. An algorithm has been developed for determining the head-discharge relationships at the outlet nodes. This enables the actual value of the piezometric head to be defined. The algorithm is based on the assignment of a series of tentative discharge rates, identical with the maximum values. By varying the set of consumption discharge rates and resolving the problem several times with these discharge rates, one can obtain a solution satisfying the head-discharge relationships with an acceptable approximation error. A simple supply system is used as an example. (Cassar-FRC)
W81-05329

LOW COST TECHNOLOGY APPLIED TO WATER TREATMENT PLANTS (APPLICATION DES TECHNOLOGIES A FAIBLE COUT AUX STATIONS DE TRAITEMENT D'EAU POTABLE),
E. Coudert, and J-C. Dernaucourt.
Aqua, No 1, p 21-24, 1981. 9 Fig, 1 Tab.

Descriptors: *Water treatment facilities, *Cost analysis, *Technology, Energy, Chemical treatment, Filtration, Sedimentation, Flocculation, Personnel.

In planning water treatment facilities, it is necessary to consider the operating costs, including energy, labor, and chemicals, as well as the construction costs. The advantages and disadvantages of slow and rapid filtration must be carefully assessed. Sedimentation tanks and flocculation processes are compared in terms of energy use. Methods for modernizing existing classical sedimentation tanks of the tunnel variety by using simple equipment to expand the sedimentation area are discussed. Biological activity in the storage reservoirs used for slow filtration can be increased through aeration or ozonization, unless granulates are used. Compact mobile treatment units which incorporate various flocculation, sedimentation, and filtration functions are available. They require only hydraulic and electrical connections and can be linked together. Units on skids, which contain reagents, back-wash filter pumps, and electrical control panels, are also available. The application of low cost technology to water treatment plants requires simplicity of construction and equipment operation, as well as a preliminary analysis of conditions. Designers and plant operators should work together, and personnel should be trained to a level of technological self-sufficiency. (Carroll-FRC)
W81-05335

6B. Evaluation Process

ASSESSMENT OF THE SANTA MARGARITA SANDSTONE AS A SOURCE OF DRINKING WATER FOR THE SCOTTS VALLEY AREA, SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
K. S. Muir.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-225021, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 81-6, April, 1981. 22 p, 6 Fig, 3 Tab, 57 Ref.

Descriptors: *Groundwater, *Aquifers, *Drinking water, *Water supply, Rural areas, Water use, Domestic water, Irrigation water, Natural recharge, Artificial recharge, Water level fluctuations, Hydraulic properties, Evapotranspiration, Water quality, Urban runoff, Pollutants, Chemical analysis, Potential water supply, Evaluation, *California, Scotts Valley area, Santa Margarita Sandstone.

Scotts Valley, Calif., is a rural residential area with a rapidly expanding population. Its mediterranean-type climate yields an average annual rainfall of 40 inches. The Santa Margarita Sandstone is the principal aquifer in the area, supplying about 90 percent of all water for domestic purposes. Sources of recharge for the Santa Margarita Sandstone are natural recharge, subsurface inflow from adjacent areas, artificial recharge, and deep penetration of excess irrigation water. Total domestic water use in 1979 was about 2,600 acre-feet. The quantity of ground water pumped for domestic use is expected to increase at a rate of 7 percent per year. Evapotranspiration, estimated to be about 29 inches per year, is the largest form of ground-water discharge. Ground water from the Santa Margarita Sandstone is generally suitable for domestic use. Potential for water-quality degradation exists from urban runoff, leachates from a solid-waste disposal site, and liquid wastes. Several agencies and individuals monitor surface-water and ground-water quality in the Scotts Valley area. Water from streams and the city of Santa Cruz are potential alternate sources of drinking water for the Scotts Valley area. (USGS)
W81-05016

1980 NEEDS SURVEY; COST ESTIMATES FOR CONSTRUCTION OF PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES.
Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
For primary bibliographic entry see Field 5D.
W81-05032

DESIGN HANDBOOK FOR AUTOMATION OF ACTIVATED SLUDGE WASTEWATER TREATMENT PLANTS,
EMA, Inc., St. Paul, MN.
For primary bibliographic entry see Field 5D.
W81-05043

AN ECONOMIC ANALYSIS OF EFFLUENT STANDARDS FOR BOD, AMMONIA, TOTAL SUSPENDED SOLIDS, AND DISINFECTION: CASE STUDY OF A MODERN TREATMENT PLANT.
Hey (Donald L.) and Associates, Chicago, IL.
For primary bibliographic entry see Field 5D.
W81-05067

THE ECONOMIC ANALYSIS OF HEALTH RISKS AND THE ENVIRONMENTAL ASSESSMENT OF REVISED FECAL COLIFORM EFFLUENT AND WATER QUALITY STANDARDS, R77-12.
Huff and Huff, Inc., LaGrange, IL.
L. L. Huff.
Illinois Institute of Natural Resources, Chicago, Document No 81/15, March, 1981, 180 p, 8 Fig, 59 Tab, 53 Ref, Append.

Descriptors: *Wastewater treatment, *Effluents, *Economic aspects, *Economic evaluation, *Cost-benefit analysis, Economic impact, Water pollution control, Disinfection, Sanitation, Estimated costs, Environmental protection, Water pollution effects, Pollutant identification.

Illinois regulations require wastewater disinfection for all domestic sewage discharges. A fecal coliform level of 400/100 ml is specified as an effluent limitation, and all general use waters must attain a level of 200/100 ml as a monthly geometric mean. The Illinois EPA has proposed the following modifications: (1) deletion of the fecal coliform water quality standard; and (2) deletion of the fecal coliform effluent standard for ll dischargers with the following exceptions: 20 miles upstream of a public supply intake, 20 miles upstream of a designated public beach area during May-September, and point souces contributing to violation of water quality standards of interstate waters. The results of the economic analysis indicate there are economic and environmental bases for modifying the existing fecal coliform and water quality standards, such as reducing operating costs to the commercial, municipal and industrial sectors, and reducing fishkills. There are currently 1,636 industrial, commercial, and municipal discharges requiring disinfection, and 90% of these discharges are currently chlorinating. The remaining 10% are in violation of the existing standard. Although it is not part of IEPA's proposed modifications, complete elimination of chlorination must also be considered, based upon the health risks of chlorinated organics versus viral and bacterial exposures. Opinions vary concerning the impact on human health of extensive disinfection and/or chlorination. (Garrison-Omniplan)
W81-05069

ECONOMIC IMPACT OF COMBINED SEWER OVERFLOW REGULATION (RULE 602) IN ILLINOIS.
Huff and Huff, Inc., La Grange, IL.
For primary bibliographic entry see Field 6E.
W81-05070

RISK OF DAM FAILURE IN BENEFIT-COST ANALYSIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W81-05119

POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS,
Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
For primary bibliographic entry see Field 5C.
W81-05168

BENEFIT-COST ANALYSIS AND DECISION-MAKING: AN EXTENSION.
DePaul Univ., Chicago, IL. Dept. of Economics.
W. Sander.
Water Resources Bulletin, Vol 17, No 2, p 315-316, April, 1981. 12 Ref.

Descriptors: *Policy making, *Water resources development, Political aspects, Governmental interrelations, Federal jurisdiction, Public policy, Administrative decisions, *Cost-benefit analysis.

Economic and social analyses play important parts in the selection of water projects. A multiple objective planning framework is provided which gives equal status to equity and efficiency objectives, and it is argued that such an approach may

not result in better projects than an approach which tries to constrain project selection to a single economic efficiency objective. A model of government is developed to justify this position. Two variables, the likelihood of coercion and the applicability of coercion, are used to define four types of policy. One type of policy is called distributive policy and is characterized by a low likelihood of coercion which is directed toward individual behavior. The second type of policy, regulative policy, is also directed towards individual behavior, although the likelihood of coercion is high, as the costs of the policy are allocated more directly. The third type of policy, redistributive policy, is applied to the environment of behavior with a high likelihood of coercion. The fourth type of policy, constitutent policy, is associated with achieving the other three types, such as by establishing a new agency. It is this last type of policy which fulfills the primary functions of government and the requirements for efficient policy implementation. (Baker-FRC)
W81-05179

SOCIAL CONSIDERATIONS ASSOCIATED WITH MARINE RECREATIONAL FISHING UNDER FCMA,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
C. P. Dawson, and B. T. Wilkins.
Marine Fisheries Review, Vol 42, No 12, p 12-17, 1980. 1 Fig, 1 Tab, 35 Ref.

Descriptors: *Sport fishing, *Marine fisheries, *Social participation, Recreation, Recreation facilities, Public waters, Legal aspects, Attitudes, Public lands, Social values.

Social and human behavior aspects of marine recreational fishing are reviewed under the optimum yield objective of the Fisheries Conservation and Management Act of 1976. The findings of the review are related to a generalized sequential model of recreational behavior. Six general factors seem to be of significance to those involved in the successful management of recreational fishing areas. The motivations and expectations of the fishermen, the satisfactions and benefits of a successful fishing experience for those who participated, typologies of various kinds of fishermen, the preferences of fishermen for various fish species, the social-demographic profiles of fishermen, and the correlations and interrelationships between the variables which measure these study topics are taken into consideration. The formulation of marine fishing regulations around these six major concerns of the fishermen will provide regulations as specific as possible and yet provide for the highest quality fishing experiences for most fishermen. (Baker-FRC)
W81-05183

FACTORS AFFECTING COST OPTIMISATION OF GROUNDWATER DEVELOPMENT SCHEMES FOR RIVER REGULATION,
Department of the Environment, Reading (England). Central Water Planning Unit.
A. B. Birtles, and E. H. Morel.
Journal of Hydrology, Vol 48, No 3/4, p 197-219, November, 1980. 8 Fig, 8 Tab, 9 Ref.

Descriptors: *Groundwater management, *Mathematical studies, *Cost analysis, Capital costs, Operating costs, Economic aspects, Aquifers, River basins, Well yield, Wells, Great Britain.

Future water resources development in many areas of Great Britain will involve the exploitation of major aquifers in conjunction with contiguous rivers. The location of boreholes in the aquifer and the manner in which they are operated can have significant influence on the economics of the schemes for such development and can affect decisions with respect to the viability of a given scheme when compared to alternatives. This study proposes a method for identifying well fields and operating regimes which minimize the total present value of capital costs and running costs which is particularly suitable for aquifers with relatively low transmissivity and high storage coefficient. The triassic sandstone in the Vale of York, Great Britain, possesses these properties and has been used to illustrate the method. Initial cost estimates have indicated that the capital costs of the type of development considered in the Vale of York area outstrip the total discount rate. These estimates suggest that well yield optimization could be based solely on capital costs, with a consequent risk of incurring a maximum cost penalty of 20 percent. Pumping schedules which would minimize running costs could then be identified as a separate exercise. The results of the application of the optimization procedure to the Vale of York show that the method is very promising and highlight various features of the hydrogeology of the triassic sandstone aquifer which are pertinent to the optimal use of the aquifer. The need to obtain reliable and detailed pumping test information in order to identify local variations of transmissivity is stressed. (Carroll-FRC)
W81-05311

PRODUCTION OF UNDERGROUND WATER IN AFRICA (DE L'EXPLOITATION DES EAUX SOUTERRAINES EN AFRIQUE).
For primary bibliographic entry see Field 2F.
W81-05331

ECONOMICS JUSTIFIES COMPUTER-CONTROL FEED,
Autocon Industries, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 5D.
W81-05339

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A REEVALUATION OF PRICE ELASTICITIES FOR IRRIGATION WATER.
California Univ. Davis. Dept. of Agricultural Economics.
R. E. Howitt, W. D. Watson, and R. M. Adams.
Water Resources Research, Vol 16, No 4, p 623-628, August, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Irrigation water, *Pricing, *Elasticity of demand, Water demand, Agriculture, Economic aspects, Linear programming.

Water demand over the price range $25-35 per acre foot is found to be slightly inelastic using the linear programming method and significantly elastic using the quadratic programming method. This model, as applied to irrigation water in California, is valid over the medium run period. Quadratic programming approaches are preferable in estimating derived demands for irrigation water because they include product demand functions, whereas linear approaches omit the elasticity of demand for the crop produced. Under drought condtition, water can be sold to the 'highest and best use' using elastic derived demand conditions, yielding greater returns to the owner of the water right. As costs increase, demand decreases under the elastic demand assumptions, thus offsetting supply shortfalls. A disadvantage of the elastic derivations is the falling revenues faced by districts with fixed debt obligations as demand decreases. To compensate for this, excess water may be sold. The quadratic programming method is a improvement over the biases inherent in linear programming methods. It may be further improved by incorporation of perennial crops and alternate irrigation technologies. (Cassar-FRC)
W81-05137

COST REDUCTIONS DUE TO SEASONAL VARIATION IN MUNICIPAL WASTE WATER TREATMENT LEVELS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics.
J. D. Epp, and C. E. Young.
Water Resources Bulletin, Vol 17, No 2, p 215-224, April, 1981. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Cost analysis, Seasonal variations, Costs, Economic aspects, Land disposal, Water quality, Model studies, Mathematical models.

The possibility of reducing treatment costs for water quality by using the higher assimilative capacity of a stream during periods of low temperature or high flow was explored. Seasonal variation in the relationship between biological oxygen demand discharges into a stream and the dissolved oxygen levels in that stream permits variations to be made in the amount of BOD that may be discharged to maintain a specified DO concentration. Variation in assimilative capacity of a stream can reduce the total costs of municipal sewage treatment. A mathematical model of Spring Creek in Centre County, Pennsylvania was used to determine the assimilative capacity for various reaches of the stream during high flow and low flow seasons. The assimilative capacitities constrain an economic optimization model, which was then used to select the least cost treatment processes for each of the three sewage treatment plants that discharge effluent into Spring Creek. When no restrictions were placed on the treatment system selected, lagoons, in some cases with filtration, provided the lowest cost treatment. A requirement to maintain phosphorus removal above 98% would increase costs 25-35%. Two general conclusions were reached. First, increasing the number of flow periods during the year enhances the opportunity for reducing treatment costs even when land treatment processes are considered. Second, treatment processes which minimize costs when operated all year may not be the least costly under multiple flow management systems. (Baker-FRC)
W81-05171

WORLD BANK WATER TARIFF POLICIES,
W. J. W. Gilling.
Aqua, No 2, p 6-11, 1980. 1 Fig, 2 Tab.

Descriptors: *Pricing, *Economic aspects, *Water supply development, Water quality standards, World Bank, Water consumption, *Africa, Water demand, Water metering, Tariff, Water policy, Social aspects.

The high costs ($1 billion per year, 1978 prices) of developing the water supply in Africa to meet the objectives of the U.N. International Drinking Water and Sanitation Decade require sound tariff policies. The World Bank examines the tariff structure of a water supply project prior to financing. The World Bank has several major concerns. Tariffs should maintain existing structures and permit expansion of systems to serve new customers; new projects should not drain the resources of the water supply agency. Alternative possibilities for achieving this are a uniform national tariff, differential tariffs (higher prices in areas of higher cost), and lower standards of service, such as standpipes or peak flow reduction. Tariffs should contribute to overall economic efficiency within the national economy. To discourage waste, water prices must be fixed so that the first 20 liters per capita per day costs less than subsequent increments. The price structure should promote widespread availability to all income groups. In addition to low cost for the basic volume of water, provisions should be made for metering high volume consumers and subsidizing initial house connections for low income users. (Cassar-FRC)
W81-05243

TARIFFICATION SYSTEMS IN AFRICA (SYSTEMES DE TARIFICATION EN AFRIQUE),
M. Chappey.
Aqua, No 2, p 13-26, 1980. 6 Tab, 3 Ref.

Descriptors: *Africa, *Water rates, *Water distribution, Pricing, Utilities, Economic aspects, Water metering, Domestic water, Industrial water, Taxes, Standpipes, Water supply.

A survey of water pricing in African countries produced six tables of data on rates, financial policies, and numbers of connections, standpipes, and meters. After a general discussion on water tariffs, standpipes and service pipes, and financial considerations, specific examples are given. Prices in francs range from 0.5 per cu meter in Mali to 292 in Botswana and Zambia. One third of the countries have degressive tariffs, one sixth have progressive tariffs, and the rest have the same tariffs

for all. Some countries, such as Sierra Leone, only meter industry and charge homes by a set rate or by a charge per tap and water-using device. Standpipes vary in pricing and in number of people served (17 per 10,000 people in Sierra Leone and one in Guinea; two or three per 10,000 is common). Service pipes and connection charges are rarely subsidized, with the exception of Niger and Ivory Coast, and sometimes are rented at 5% of capital cost. Sewerage charges are about 40% of total cost. Water is generally not taxed. Financial figures are given for the utilities but not compared because the currency and inflation differ widely. (Cassar-FRC)
W81-05330

PRESENT AND PROSPECTIVE METHODS OF READING METERS AND BILLING WATER CONSUMPTION (METHODS ACTUELLES ET PROSPECTIVES EN MATIERE DE RELEVE DES COMPTEURS ET DE FACTURATION DES CONSUMMATIONS D'EAU),
Compagnie Intercommunale Bruxelloise de Eaux (Belgium).
A. Desmed.
Aqua, No 3, p 55-65, 1980. 4 Fig, 41 Ref.

Descriptors: *Water metering, *Automation, *Economic aspects, Data processing, Decision making, Water costs, Water management, Utilities, Pricing.

A main objective of water utility management is optimization of meter reading and billing methods. Possible ways of reducing costs for billing and metering are remote or automatic meter reading, optimization of manual reading (reduction of number of meter readings, estimated readings, consumer self-readings, efficient routes for meter readers, and integration of readings for gas, water, and electric), and incorporating data processing methods. A formula is presented to determine the optimum threshold for beginning billing. The importance of meter reading accuracy may be shown by the formula: error probability times cost of the error consequence. If this result exceeds the cost of the operation (in this case, meter reading and billing), another method would be cheaper. Calculations for the Compagnie Intercommunale Bruxelloise des Eaux indicated that replacing meter reading with automatic calculations would save $257,120. (Cassar-FRC)
W81-05333

DATA PROCESSING AND WATER SUPPLY BILLING (FACTURATION D'EAU ET INFORMATIQUE),
Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
C. Maffet.
Aqua, No 3, p 50-54, 1980. 3 Fig.

Descriptors: *Data processing, *Billing, *Water supply, Pricing, Computerized billing.

The Societe Lyonnaise des Eaux et de l'Eclairage, serving 1.8 million water and sewage connections, installed a new centralized computerized billing procedure in 1976. This article describes the steps leading to the development of the system; administrative details (contracts, regulations, laws, etc.); a series of questions to collect and arrange data for processing; and a series of questions to determine layout of the printed bill. The files include information on customer, civil status, meter installed, service rendered, billing department, amount to be paid, methods of payment, estate being supplied, calculation of consumption, and proper account of payments. The data processing includes four program sequences; updating files, calculation of water consumption (28 possible methods), calculation of sums due involving unit tariffs or lump sum tariffs, and printing. (Cassar-FRC)
W81-05346

6D. Water Demand

CONSERVATION--GETTING THE BALANCE RIGHT.
Newcastle Upon Tyne Univ. (England).
B. Hackett.
Water, No 30, p 27-29, January, 1980.

Descriptors: *Conservation, *Great Britain, *Water management, Water resources development, Resources management, Wildlife conservation, Recreation facilities, Public policy.

There is a need for the development of a concept of conservation with respect to the water industry which includes both respect for the natural resources of the environment and the need to develop these resources in a manner that stresses the harmonization of human activities with the natural environment. A balance must be reached between developing water resources for domestic and industrial uses and maintaining water resources in suitable form to meet the needs of agriculture, horticulture, fisheries, and forestry. The management of wetlands in Great Britain exemplifies the problems faced by water authorities in that country. While farmers would like to drain these lands to increase their agricultural productivity, nature conservationists are concerned about the destruction of natural habitats. Current British legislation requires water authorities to develop the recreational use of reservoirs and land resources as much as possible. Water authorities can increase the recreational use of reservoirs and other water resources by improving public access, developing picnicking places, encouraging bird watching activities, and promoting sailing and angling. Conflicts between different types of recreational use of water resources can be resolved by zoning parts of a reservoir for each activity, allocating different days and/or times of day to different activities, or assigning different types of activities to different water bodies. (Carroll-FRC)
W81-05270

RIVER BASIN HYDRO-SALINITY-ECONOMIC MODELING,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W81-05310

STUDIES INTO THE DOMESTIC CONSUMPTION AND PEAK CONSUMPTION OF DRINKING WATER IN SWITZERLAND (ETUDES SUR LA CONSOMMATION DOMESTIQUE ET LES PONTES DE CONSOMMATION D'EAU DE BOISSON EN SUISSE),
SSIGE, Thalwil (Switzerland).
T. Pitsch.
Aqua, No 1, p 7-13, 1980. 13 Fig, 1 Tab, 9 Ref.

Descriptors: *Water consumption, *Water demand, *Peak demand, Water use, Drought, *Switzerland, Domestic water, Drinking water, Water metering, Temperature.

International statistics indicated that Switzerland has one of the highest per capita domestic water consumptions in the world, 250 liters per person per day. The Swiss Association of Gas and Water Engineers attempted to survey domestic consumption more accurately using the Universal Consumption Analyzer, which indicates the curve showing frequency and permanent demand. A differential study was performed on 13 units (family homes, hotels, apartments), determining the probable peak flow and duration for each. These values were in reasonable agreement with previously used measuring criteria and confirmed differences in types of consumers. Statistics obtained from 45 water boards (32% of the Swiss population) show a gradual increase in water consumption from 426 liters per person per day in 1960 to 506 in 1971. Since 1972, a drought year, the consumption rate of increase has dereased. The drought year 1976 was an anomaly--peak consumption was about 900 liters per capita per day. These unusual peaks of up to 200% of normal consumption occurred when the average temperatures exceeded 20C. Rising consumption in June 1976 led to water restrictions beginning about June 28. This caused a rapid drop in use; normal or below-normal levels were reached after about 10 days. Although both average and peak consumptions generally follow a regular pattern, utilities must be prepared to deal with the unexpected and with exceptions to the rule. (Cassar-FRC)
W81-05337

PREDICTION OF FUTURE WATER DEMAND,
Japan Water Works Association, Tokyo.
S. Naito.
Aqua, No 2, p 35-37, 1980. 7 Tab.

Descriptors: *Water demand, *Water consumption, *Standard deviation, *Thailand, Prediction.

A study of water consumption in Thailand allowed predictions of water demand by the standard deviation method. Per capita water consumption estimates (liters per day) for the year 2000 for municipalities in three population categories were as follows: less than 50,000 population, 155; 50,000 to 100,000 population, 175; and for cities over 100,000 population, 200. Monthly and hourly variations in water consumption in a small municipality with a refinery and a fishery are tabulated. In 1970 monthly maximum and minimum per capita water uses were 215.1 liters per day in February and 145.7 in October. (Cassar-FRC)
W81-05344

6E. Water Law and Institutions

MUNICIPAL INTERGOVERNMENTAL RELATIONS AND WATER RESOURCES DECISION MAKING IN THE TRIANGLE 'J' REGION,
North Carolina State Univ. at Raleigh. Dept. of Political Science.
T. D. Edgmon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246274, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina Report No 166, June, 1981. 130 p, 3 Fig, 18 Tab, 2 Append. OWRT-A-114-NC(1), 14-34-0001-0135.

Descriptors: *Governmental interrelations, *Water management, Water supply, Water resources, Development, Water supply management, Regional planning, *Policy making, Wake County, Johnston County, Chatham County, Durham County, Lee County, Orange County, *North Carolina, *Municipal water.

This report describes the structure of organization of municipal water supply systems, and analyzes the pattern of intergovernmental relations within the six-county planning jurisdiction of the Triangle 'J' Council of Governments. The study objectives were to determine the existing status of water resources intergovernmental relations in the Triangle 'J' Planning Region, determine existing local government policy maker perceptions of the importance of water supply issues and intergovernmental relations, and propose and evaluate the political acceptability and feasibility of alternative areawide water supply institutional arrangements. The research concludes that areawide water supply issues and problems vary across sections of the six-county region, and that interaction is greatest among municipalities within specific counties rather than across county lines. In addition, five distinct types of areawide water supply management have been identified as operative within the study area, and the three in Wake, Johnston, and Chatham Counties are currently undergoing change. The direction of this change in these counties is the same: toward the realignment of relationships among municipal water suppliers, county government, and smaller incorporated and unincorporated urbanizing fringe areas. A preliminary evaluation of alternative areawide management strategies indicates that local officials tend to support strategies which would enhance supplies without a commensurate loss of municipal autonomy. Thus, strategies which maximize representation among local governmental units while meeting regional water supply demand are more feasible from a political standpoint than alternatives which involve the organization of governmental units on higher levels of government.
W81-05003

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE STEAM ELECTRIC POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119075, Price codes: A99 ($41.00) in paper copy, A01 in microfiche. Report EPA-440/1-80/029-b, September, 1980. 618 p, 70 Fig, 200 Tab, 128 Ref, 3 Append.

Descriptors: *Electric power industry, *Industrial wastes, *Wastewater treatment, *Water pollution sources, Effluents, Pollutants, Suspended solids, Oil, Grease, Residual chlorine, Metals, Polychlorinated biphenyls, Zero discharge, Costs, Energy, *Water quality standards.

This revision of effluent guidelines, performance and pretreatment standards for the steam electric power generating industry deals only with chemical pollutants, and focuses on the 129 priority pollutants. The existing BPT guidelines for pH, PCB's, total suspended solids, oil and grease, copper, iron, free available chlorine, are revised to BAT levels. The free available chlorine standard is changed to total residual chlorine. The new source limitations are the same as the BAT limitations, with the exception of zero discharge of residual chlorine from once-through cooling water. Pretreatment standards for existing and new sources (PSES and PSNS) are generally the same as the BAT limitations. Zero discharge of fly ash water will be required for new sources. The control technologies to achieve the pollutant limitations are discussed, and the cost, energy, and non-water quality aspects of implementing them are estimated. (Brambley-SRC)
W81-05026

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT, STANDARDS FOR THE PULP, PAPER AND PAPERBOARD AND THE BUILDERS' PAPER AND BOARD MILLS POINT SOURCE CATEGORIES.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W81-05036

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE BATTERY MANUFACTURING POINT SOURCE CATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W81-05062

EFFLUENT CHARGES FOR WATER POLLUTION CONTROL IN CALIFORNIA,
W. D. Carson, Jr.
California State Water Resources Control Board, Sacramento, Report, May, 1980. 68 p, 1 Fig, 3 Tab, 56 Ref.

Descriptors: *California, *Effluent charges, *Pollution taxes, *Nonpoint pollution sources, *Wastewater disposal, *Water quality standards, Pollution load, Water quality control, Wastewater outfall, Effluent standards, Water quality management, Effluents, Simulation analysis, Pollution control, Pollution abatement.

This report stems from a research project to identify an area of the water pollution control program in California where the application of effluent charges could be effective and beneficial. The project incorporates a case study of Lake Tahoe as an example of potential application of effluent charges and a model for answering difficult questions of implementation of such charges. Taxes or charges are seen as preferable to direct controls, except in terms of political acceptability. The report attempts to improve political acceptability by clarifying certain issues. It recommends (1) that charges be administered by the Regional Boards, since water quality management problems are regional in nature, and (2) that monitoring be a combination of self-reporting by the discharger and random audits by the Regional Boards. Numerous questions regarding implementation of effluent charges are examined. The report suggests that effluent charges can be applied to water quality control problems only in a simulation model that requires information on technology, pollution transfer, water quality, and treatment costs. Simulation studies of effluent charges applied to industrial point sources of water pollution have also shown effluent charges to be more efficient than uniform percentage reduction. Suggested uses of generated revenue, relevant federal legislation, administrative costs, and an extensive bibliography are included. (Garrison-Omniplan)
W81-05066

ECONOMIC IMPACT OF COMBINED SEWER OVERFLOW REGULATION (RULE 602) IN ILLINOIS.
Huff and Huff, Inc., La Grange, IL.
L. L. Huff.
Illinois Institute of Natural Resources, Chicago, Document No. 81/18, April 1981. 203 p, 17 Fig, 46 Tab, 21 Ref, Append.

Descriptors: *Illinois, *Combined sewer overflows, *Sewer systems, *Administrative regulations, *Economic evaluation, Economic impact, Cost-benefit analysis, Sanitation, Estimated costs, Economic aspects, Water quality, Water pollution effects, Rainfall rate.

Combined sewer overflows (CSO) are sources of pollution which are expensive to control and difficult to quantify. Combined sewer systems in Illinois are designed to carry storm water and sanitary waste, and may contain between one and forty-five overflow points for excess flows during storm events. According to Rule 602 all first flush as determined by Illinois EPA must receive secondary treatment, and additional flows not less than ten times the dry weather flow must receive a minimum primary treatment and disinfection with adequate retention time. Seven alternatives that provide a range of treatment requirements and discharger categories were considered to evaluate the cost-effectiveness of Rule 602. The report recommends that CSO be evaluated on a case-by-case basis following an IEPA technical policy similar to that of the U.S. EPA for analyzing costs and water quality concerns. CSO loadings should be evaluated as one factor affecting stream water quality, with some effort to relate other factors to the water quality goal. Rule 602 is inflexible in that all communities must provide the same level of treatment regardless of stream size, non-point source contributions, water quality impacts, or economic hardship. In the recommended evaluation, size factors should be a major consideration. However, analysis of alternatives indicated that no general rule can readily replace 602 without causing new water quality and economic uncertainties. (Garrison-Omniplan)
W81-05070

NEW APPROACHES TO WATER UTILITY PLANNING,
Washington State Dept. of Social and Health Services, Olympia.
A. K. Rowe, and D. K. Sander.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 139-148, March, 1981.

Descriptors: *Regional planning, *Water supply development, *Utilities, *Washington, Legislation, Water resources development, Planning, Water policy, Water law, Growth, Land use, Drinking water.

The State of Washington has two recent laws which allow water utilities to predict future needs and be assured that their plans may be implemented. These are the Water Resource Act of 1971 (WRA) and the Public Water System Coordination Act of 1977 (PWSCA). The WRA provides a system for setting aside water supplies for future domestic needs, so that utilities do not have to periodically renew water rights or construct facilities prematurely to reserve supplies. Water is reserved by region rather than by system. Two regions have already secured their future supplies, and several more are working on plans to do similarly. The PWSCA provides a step by step process for water utilities and local governments to coordinate utility growth with local development policies. To date, six critical water supply service areas have been declared under this law, four of these in rapidly growing areas. Eleven additional counties are considering this action. The product of these laws is the Coordinated Water System Plan, which serves as a common bond linking water resources, land use, and drinking water supplies. This plan, developed in a cooperative manner at the local level and enforced by state agencies, is gaining wide acceptance and may be a model for other states. (Cassar-FRC)
W81-05098

BUREAU OF RECLAMATION PLANNING: ENVIRONMENTAL FACTORS,
California Public Utilities Commission, San Francisco.
J. E. Price, and L. Ortolano.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 27-43, March, 1981. 1 Tab, 13 Ref.

Descriptors: *Environmental policy, *Governmental interrelations, *Planning, Public participation, Statistical analysis, Natural resources, Water resources development, Political aspects, Multipurpose projects, Research, Decision making, Regional planning.

The Bureau of Reclamation, recently renamed the United States Water and Power Resources Service, is a Federal agency responsible for planning and implementing multipurpose water resources development in the 17 western states. Since the Bureau is required to generate considerable environmental information, research on practices and procedures most effective in increasing consideration given to environmental concerns was initiated. Results of this statistical analysis show that in feasibility investigations, environmental information is likely to have a greater influence on planning outcomes if an interdisciplinary planning process is used. This involves active use of planning teams which include environmental specialists, participation of environmental specialists in planning, and a high degree of informal coordination between engineers and environmentalists. For specific plan investigations, environmental specialists are most advantageously used to review proposed plans. The importance of input from other agencies and from the public must not be underestimated. Outside interests may participate most effectively in planning as follows: in the early stages, involvement in the planning process; and in the later stages, formation of alliances between citizen groups and conservation agencies and lobbying rather than environmental litigation. For feasibility studies involvement means planning teams and advisory committees; for definite plan investigations, public meetings. (Cassar-FRC)
W81-05099

URBAN STORMWATER MANAGEMENT IN SOUTHEAST,
North Carolina State Univ. at Raleigh.
D. H. Howells, and N. S. Grigg.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 149-166, March, 1981. 2 Ref.

Descriptors: *Urban areas, *Storm water, *Ordinances, Erosion control, Sediment control, Flood plain management, Storm runoff, Water pollution control, Drainage, Water policy, Legal aspects, Regional analysis, Southeast U.S.

This paper describes the conclusions of the Southeast Conference on Urban Stormwater management, held April 10-11, 1979. It was the third of a series of conferences concerned with major water resource problems in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. Some of the conclusions were: (1) the four areas of stormwater management (drainage and detention, flood plain management, erosion and sedimentation control, and stormwater pollution control) should be addressed within a unified program, (2) commitment to implementing an ordinance is lacking in some communities, (3) ordinances should concern policy, not technical details, (4) local ordinances should not conflict with state legislation, (5) ordinances should be drafted by an interdisciplinary team and involve public participation in all phases, (6) model ordinances from other communities must be adapted to local needs, (7) on-site detention is still subject to debate, (8) many local governments do not have the capabilities to handle stormwater management or Flood Insurance Program obligations, and (9) existing laws in erosion control, sediment control, and pollution control are not rigorously enforced in all locations. (Cassar-FRC)
W81-05100

STATUS OF SOUTHEAST RIVER BASIN WATER RESOURCES,
South Carolina Water Resources Commission, Columbia.
C. P. Guess, Jr.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 105-111, March, 1981. 2 fig.

Descriptors: *Water policy, *Water demand, *Regional planning, Regional development, Regional analysis, Water resources development, Planning, Water management, Water law, Water quantity, Evaluation.

The Second National Water Assessment of 1975 for the South Atlantic-gulf Water Resources Region indicates an overall well-balanced supply demand ratio for water. This area has an annual rainfall of 41 to 80 inches, and most of the river basins are parallel, flowing in a north-northwest to south-southeast direction. Areas where problems have been identified are listed in the following classifications; fresh-surface water quantity, groundwater quantity, and fresh-surface water quality. In the Southeast agricultural irrigation is increasing rapidly. In south Carolina the number of acres of irrigated land has doubled since 1978. In the past, most projects have been single-purpose. Presently authorized projects are multipurpose, providing recreation, flood control, low flow augmentation, and fish and wildlife habitats. The Southeast's plentiful water resources must be managed carefully in the future, paying attention to long term planning, interstate cooperation, and improved technology.
W81-05101

GROWTH CONCERNS DEFEAT A COUNTY WATER ISSUE,
Montgomery (James M.), Inc., Irvine CA.
C. H. Lawrance.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 183-199, March, 1981. 4 Fig, 1 Tab, 39 Ref.

Descriptors: *Political aspects, *Imported water, *Water supply development, Economic growth, Population growth, State water project, *California, Santa Barbara County, *Bond issues, Economic aspects, Social aspects, Water conservation, Water rights, Weather modification, Aqueducts, Reclamation.

In March 1979 the Santa Barbara County, California, voters rejected a $102 million bond proposal which would have permitted the importation of water from the State Water Project. Opponents were afraid that importation would induce industrial and population growth and damage the environment. They also objected to the high initial costs and the high pumping costs. Proponents pointed out the eventual need, the availability to many areas, and the high water quality. The alternatives to importation (wastewater reclamation, watershed management, weather modification, desalination, dam construction, conjunctive use, etc.) were local, lower yield water resources alternatives, with demand limited by local growth management and consumer conservation. This paper presents an overview of the technical, socio-economic, environmental, and political considerations that led to the voters' decision. the writer feels that rejection of the bond issue has only postponed the county's water problem solutions. (Cassar-FRC)
W81-05103

WOODBURY COUNTY SOIL CONSERVATION DISTRICT V. ORTNER: NEW AUTHORITY FOR REQUIRED SOIL CONSERVATION,
J. R. Mohrhauser.
South Dakota Law Review, Vol 25, No 3, p 614-621, Summer, 1980.

Descriptors: *Judicial decisions, *Water rights, *Soil conservation, Legal aspects, Water law, State jurisdiction, Soil conservation, Erosion, Law enforcement, Agriculture.

An Iowa Supreme Court case that affirmed that the Commissioners of a soil conservation district may enforce the district's soil loss regulations by requiring landowners to adopt specific soil conservation practices is reviewed. The case, Woodbury County Soil Conservation District v. Ortner, held that section 467A.44 of Iowa's Soil Conservation Districts Law was a valid exercise of the state's power. Soil conservation is the most effective way of controlling agricultural soil erosion and thus limiting this threat to water quality. In this case, farmers who were losing 7.9 to 77.2 tons per acre of soil per year were ordered to reduce soil loss to 5 tons per year or lower. Portions of each farm were to be seeded to hay or permanent pasture, or terracing had to be established. Both of these alternatives would have cost the farmers considerable money, and they refused to comply with the soil conservation district's orders. In the decision, it was implied that the public has a duty to provide assistance to individual landowners who are required to make expenditures that will benefit future generations. (Small-FRC)
W81-05107

TAXATION OF WATER RIGHTS,
Moses, Wittemyer, Harrison and Woodruff, Boulder, CO.
R. J. Moses, and M. W. Witten.
South Dakota Law Review, Vol 25, No 3, p 475-496, Summer, 1980. 102 Ref.

Descriptors: *Judicial decision, *Water rights, *Taxes, Legal aspects, Water law, State jurisdiction, Water permits.

The laws of different states were surveyed to investigate whether water rights are taxable as property. Usually, an appropriated water right is used to the benefit of some other property subject to taxation, and the assessment of that property will show an increase which represents, in theory, the value of the water right. Some states specifically include at least some water rights in their statutory definitions of real property subject to taxation. Kansas and Nebraska laws refer to mineral springs and wells, while Oregon law defines real property subject to taxation to include all water rights and water powers. Oklahoma includes permanent irrigation as taxable property, and North Carolina, Iowa, and Wyoming all implicitly include water rights in their definitions of taxable property by including water rights and privileges in assessing land value. In Colorado, water rights are improvements to real estate. South Dakota has considered passing a bill which would tax each water permit by the number of acre-feet of water granted the individual permit. This would be a straightforward way of handling what is now a tangled legal situation. (Small-FRC)
W81-05108

INTRODUCTION: STATE AND LOCAL LAND USE PLANNING AND CONTROL IN THE AGRICULTURAL CONTEXT,
Florida Univ., Gainesville.
J. C. Juergensmeyer.
South Dakota Law Review, Vol 25, No 3, p 463-474, Summer, 1980. 30 Ref.

Descriptors: *Land use planning, *Agriculture, *Water use, Water conservation, Recycling, Irrigation practices, Legal aspects, Water policy.

The role of state and local land use planning and its effect on agriculture are discussed. Priorities in water use should be resource oriented, and priorities governing water use should be determined according to the importance of various required activities. Water policy should be based on quantitative estimates of the limitations of water resources. The limitations of this resource must be considered in land-use planning decisions. Where possible, water conservation should be practiced. Urban effluent and excess irrigation water can be used, recycled, and reused by agriculture. Rainfall retention should be as complete as possible, and the release of water should be kept as close to the natural discharge pattern as possible. This will moderate wet and dry cycles and eliminate water pollution from other sources. Agricultural practices that minimize water pollution from diffuse sources (nonpoint) should be encouraged. (Small-FRC)
W81-05109

UNITED STATES RECLAMATION POLICY AND INDIAN WATER RIGHTS,
New Mexico Univ., Albuquerque. Dept. of Economics.
H. S. Burness, R. G. Cummings, W. D. Gorman, and R. R. Lansford.
Natural Resources Journal, Vol 20, No 4, p 807-826, October, 1980. 5 Tab, 48 Ref.

Descriptors: *Legal aspects, *Water rights, *Reclaimed water, Public policy, *Indian water rights, Reservation doctrine.

Many law suits concerning the water rights of American Indians on reservations have centered on the meaning of the expression 'practicably irrigable acreage'. This paper traces the evolution of the United States policy with respect to water reclamation from its inception in the late 1800s to the present and examines the ramifications of these policies with regard to the determination of the feasibility of proposed water reclamation projects. If the courts should equate practicability with feasibility, the ideas presented in this paper suggest a means for demonstrating practicability consistent with the methods used by Federal agencies in demonstrating project feasibility. Federal legislation and institutional changes since 1877 suggest that water resources development in the West has been a sustained national goal since that time. The apparent inability of agriculture to pay its fair share of water reclamation project costs led to passage of a number of relief acts. The Reclamation Act of 1939 recognized public benefits from reclamation projects and introduced the idea of non-reimbursable costs. Agriculture's repayment of its allocated costs has since been guided by the principle of ability to pay, with excess power revenues picking up any deficit. A review of 62 feasibility studies conducted by the Bureau of Reclamation since 1947 suggests several rules to be followed in evaluating potential Indian irrigation projects. Benefits should be evaluated within a very broad context which considers benefits which may be experienced by any parties. The relationship between social benefits and costs, independent of repayment considerations, should be used to determine project feasibility. Issues regarding the repayment by irrigation of Federal funds used for constructing the project are separate from demonstration of project feasibility. Capital costs forgiven or deferred by the Leavitt Act are essentially comparable to the costs forgiven irrigators in non-Indian projects by the assignment of power revenues to costs in excess of ability to pay. (Carroll-FRC)
W81-05110

STORMWATER RUNOFF CONTROL: A MODEL ORDINANCE FOR MEETING LOCAL WATER QUALITY MANAGEMENT NEEDS,
Spessard L. Holland Law Center, Gainesville, FL.
F. E. Maloney, R. G. Hamann, and B. D. E. Canter.
Natural Resources Journal, Vol. 20, No. 4, p 713-764, October, 1980. 196 ref.

Descriptors: *Ordinances, *Legal aspects, *Storm runoff, Storm water, Water quality management, Water pollution control, Water pollution prevention, Urban runoff, Runoff.

Although most water pollution abatement programs are directed toward the elimination of point sources of water pollution, about 50 percent of water pollution in the United States is due to waste picked up from the land by rainfall which reaches ground and surface waters through runoff and seepage. This paper presents a model stormwater runoff control ordinance which was developed to provide local governments with an effective mechanism for responsible stormwater management. The environmental impacts of stormwater runoff and the roles of natural systems and of land development in runoff pollution problems are described. General control techniques which can effectively reduce the harmful impacts of stormwater runoff are discussed. Proper location, design, construction, and maintenance of new urban development and its associated drainage systems provide the best opportunity for water quality protection. Common law applicable to diffused surface water problems includes rules related to drainage rights and liability for water pollution. Federal law stimulating the search for methods of controlling nonpoint source pollution consists primarily of provisions of the Federal Water Pollution Control Act and its subsequent amendments. Legal considerations bearing on the implementation of the model ordinance include issues relating to the power to regulate, the delegation of legislative authority, reasonable, police power regulation, equal protection, and the taking issue. The model ordinance is intended to require the implementation of stormwater runoff management practices that protect the absorptive, purifying and retentive functions of natural systems that exist on the site of a proposed development and that provide for post-development stormwater runoff characteristics that resemble the conditions that existed before the site's alteration. The complete model ordinance is included, with commentary. (Carroll-FRC)
W81-05111

ECOLOGICAL ASPECTS OF AGRICULTURAL POLICY,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
For primary bibliographic entry see Field 2J.
W81-05113

SUPERFUND PROPOSED TO CLEAN UP HAZARDOUS WASTE DISASTERS,
C. L. Anderson.
Natural Resources Journal, Vol 20, No 3, p 615-623, July, 1980. 63 Ref.

Descriptors: *Hazardous materials, *Solid waste disposal, *Disasters, Waste disposal, Federal jurisdiction, Oil spills, *Cleanup operations, Insurance, Economic aspects, Industrial wastes.

Several bills pending in the U. S. Congress in early 1980 proposed to establish funding mechanisms for cleaning up hazardous waste disasters. The bills propose the creation of a public trust fund consisting of varying combinations of industry-levied fees and government appropriations to be used for the cleanup of oil spills, hazardous waste spills, and/or abandoned dump sites. Between 1,200 and 2,000 hazardous waste sites in the United States now pose dangers to human health, and only about 10 percent of hazardous wastes currently being produced are disposed of in an environmentally safe manner. Federal legislation which givens broad authority for responding to a wide range of hazardous waste spills and abandoned and operating sites is needed. It is suggested that debate over whether industry or government should pay for cleanup operations is somewhat academic, since taxpayers and consumers will shoulder the cost eventually in either case. If the fund is funded from government appropriations, government policy should include liberal liability thresholds and generous compensation provisions, creating a national insurance against the ruinous effects of a hazardous waste disaster. (Carroll-FRC)
W81-05114

PROTECTION OF THE MEANS OF GROUNDWATER DIVERSION,
K. J. Bliss.
Natural Resources Journal, Vol 20, No 3, p 625-651, July, 1980. 146 Ref.

Descriptors: *Legal aspects, *Water rights, *Usufructuary right, Groundwater availability, Groundwater management, Groundwater potential, Judicial decisions, State jurisdiction, Public rights, Relative rights.

Water policy is a crucial political issue in the western states, where water is a vital component of the economic existence and future development. Although the idea that individual rights in water should be protected to encourage investment and development was predominant in earlier times, the current acute demand for water has led to a demand that public policy balance the rights of the individual against the present objective of maximizing water resources. The case of Mestas versus Elephant Butte Irrigation District is used to demonstrate the conflict arising from a shortage of water created by increasing demand in New Mexico. New Mexico has retained a system or prior appropriation with respect to both groundwater and surface water under which initial users of the groundwater are seen as having a right to continued used in areas in which the State Engineer has designated the existence of a declared basin. A variety of cases are used to demonstrate the concept of the right of prior appropriators to their means of groundwater diversion and changes in emphasis which time and the ever-increasing demand for water in the west have brought to this area of the law. The doctrine of Reasonable diversion has been developed by the courts as a limitation on the private right of prior appropriation in order to further a public policy of maximum economic development. However, this doctrine sacrifices the water needs of future generations to unlimited consumption of groundwater in the present. It is recommended that States evaluate public policy with respect to groundwater in light of long-range needs and that judicial decisions reflect public policy in this area. (Carroll-FRC)
W81-05115

NEW MEXICO'S MINE DEWATERING ACT: THE SEARCH FOR REHOBOTH,
G. Gottlieb.
Natural Resources Journal, Vol 20, No 3, p 653-680, July, 1980. 3 Tab, 106 Ref.

Descriptors: *New Mexico, *Mining engineering, *Groundwater depletion, Groundwater management, Aquifers, State jurisdiction, Legislation, *Legal aspects, Water management, Uranium.

Groundwater is a vital resource in New Mexico, where its availability has been a major factor in economic development. Intensive uranium mining in the northwestern quadrant of the State has led to growing conflicts regarding the management of groundwater resources in that area. Underground mining of uranium requires that water be removed from the host rock by continual pumping of water out of the acquifer during construction of the mine shaft. This process often results in the impairment of the water rights of other users of the acquifer. Under New Mexico law, prior appropriators of water have a water right which may be protected against impairment by subsequent users as long as the water is put to a beneficial use. The Mine Dewatering Act is designed to resolve the conflict between the prior appropriation doctrine in present New Mexico water law and the needs of the mining industry. This Act brings nearly all new dewatering projects under the jurisdiction of the State Engineer and contains provisions allowing the inclusion of many existing dewatering activities. However, the Act presents many structural and constructional problems and fails to resolve important resource management problems. It may violate the State constitution by recognizing a nonbeneficial use of water; the use of the words impairment and adequate may cause interpretational problems; and the grandfather clause may result in administrative difficulties. The Act raises questions concerning the effect on Federal reserved rights and the duration and transferability of water rights. The ability of the State Engineer to manage New Mexico's groundwater resources is also seriously imperiled by the Act. (Carroll-FRC)
W81-05116

WORLD BANK WATER TARIFF POLICIES,
For primary bibliographic entry see Field 6C.
W81-05243

INTERNATIONAL ASPECTS OF WATER POLICY,
Ministry of the Environment, Paris (France).
T. Chambolle.
Aqua, No 7, p 7-8, 1980.

Descriptors: *Water policy, *International commissions, Water pollution control, Political aspects, Oil pollution.

With the recognition that water resources management crosses national boundaries, several international agreements and commissions have been established to deal with water policy. The European Community Council was adopted in 1973 to coordinate the water policy of nine member nations. Other commissions handle problems relating to Lake Geneva, the Rhine River, the Sarre and Moselle Rivers, and Belgium-Luxembourg-France. Marine pollution conventions include the 1954 London Convention, the 1973 and 1978 MARPOL Convention concerning tanker ballasting wastes, the 1969 Bonn agreement, 1976 Barcelona Protocol, 1969 Brussels Convention, and the convention concerning noxious waste dumping in the ocean. Telluric-origin pollution is regulated by the 1974 Paris Convention and the 1980 Athens Protocol. (Cassar-FRC)
W81-05244

DISCHARGE STANDARDS BASED ON GEOMETRIC MEAN,
California Univ., Davis. Dept. of Civil Engineering.
S. Niku, F. J. Samaniego, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 471-473, April, 1981. 1 Tab, 15 Ref.

Descriptors: *Effluent standards, *Standards, *Water pollution control, *Wastewater discharge, Biological oxygen demand, Suspended solids, Geometric mean, Arithmetic mean, Statistical analysis, Regulations, Secondary wastewater treatment, Wastewater treatment.

The EPA discharge standards for secondary treatment effluent are based on the arithmetic mean of BOD and suspended solids. This paper compares the arithmetic mean and geometric mean approaches and suggests that future standards be based on thresholds for single, day, 7-day, and 30-day geometric means. This would require changes in the standards. Since the geometric mean is relatively insensitive to outliers, standards should designate BOD values exceeding an upper limit on a single day as a violation. (Cassar-FRC)
W81-05280

ALTA: A CLASSIC CONFRONTATION,
G. Parmann.
Ambio, Vol 10, No 2/3, p 152-153, 1981. 1 Fig.

Descriptors: *Public opinion, *Water resources development, Planning, Public relations, Benefits, Alta, *Norway, Dams, Economic aspects.

Demonstrators confronted police in the town of Alta in northern Norway. The demonstrators were

environmentalists desirous of preserving unspoiled one of the most beautiful and ecologically important areas in Norway and maintaining the rights of the native people of the region, the Samis or Lapps. The government of Norway wants to develop cheap hydroelectric power from one of the last untapped rivers in the Norwegian north. The conflict began in 1969 when the first plans for the use of the Alta-Kautokeino watercourse for hydroelectric power production were published. Part of the plan called for construction of a dam that would leave the Sami village of Masi under water. Despite protests from various concerned groups, the Norwegian Parliament decided to develop hydroelectric power in the Alta river. However, the Society for Nature Conservation took the Government to court, seeking an order to have the parliamentary decision declared invalid because the advantages of the project did not outweigh the disadvantages. Finally a hunger strike of a small group of Samis in Oslo took place on the grounds of the Parliament Building. Protests spread throughout the population and the government had to postpone its plans. Confrontations continue, with the planned completion date of the plant being 1986. (Baker-FRC)
W81-05326

6F. Nonstructural Alternatives

CONSERVATION--GETTING THE BALANCE RIGHT.
Newcastle Upon Tyne Univ. (England).
For primary bibliographic entry see Field 6D.
W81-05270

6G. Ecologic Impact Of Water Development

DESCRIPTIVE WATER QUALITY FOR THE ATCHAFALAYA BASIN, LOUISIANA,
Environmental Monitoring Systems Lab., Las Vegas, NV.
S. C. Hern, V. W. Lambou, and J. R. Butch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202328, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/4-80-014, February, 1980. 180 p, 13 Fig, 12 Tab, 34 Ref, 6 Append.

Descriptors: *Water quality, *Flooding, *Productivity, *Food chains, Bacteria, Detritus, Flood control, Nutrients, Nitrogen, Phosphorus, Hydrological regime, *Wetlands, Organic matter, Atchafalaya Basin, Louisiana.

The Atchafalaya Basin in south-central Louisiana is a large alluvial basin whose wetlands are of national significance. The Basin extends inland from the Gulf of Mexico for a distance of 125 miles to the confluence of Red River and distributary flows from the Mississippi River. To meet the need for flood control, the Army Corps of Engineers is considering hydrological modifications for the Basin. Water quality in the Atchafalaya Basin is described in terms of geographical areas, seasonal patterns, and its relationships to water regimes and water quality in the Basin is compared to water quality in other Louisiana and southeastern lakes. Emphasis in this report is given to water quality in the Atchafalaya Basin Floodway, i.e., that portion of the Atchafalaya Basin subject to frequent and prolonged natural overbank flooding and most subjected to hydrological modifications by man. The key to the high productivity of the Floodway is the short, efficient, bacteria-detritus food chain. Organic matter processed through bacterial metabolism represents the foundation of the system. Nitrogen and phosphorus levels are sufficient for bacterial metabolism of organic matter, regardless of geographical area, season, or water level. Prolonged overbank flooding, with the inundation of additional land areas containing herbaceous material and forest litter, renews the carbon resources needed to drive the bacteria-detritus system. It is recommended that to maintain the highly efficient bacteria-detritus food chain, the extent, duration, and depth of natural flooding must be maintained to the greatest degree possible. (Moore-SRC)
W81-05052

CHANNELIZATION AND LIVESTOCK IMPACTS ON SALMONID HABITAT AND BIOMASS IN WESTERN WASHINGTON.
D. W. Chapman, and E. Knudsen.
Transactions of the American Fisheries Society, Vol 109, No 4, p 357-363, July, 1980, 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Channeling, *Fish, Habitats, Aquatic habitats, Environment, Streams, Biomass, *Ecological effects, Water quality control, *Washington.

Channelized and livestock-impacted streams were sampled in three periods: June 1 - July 30, 1978, August 1 - September 30, 1978, and midwinter, 1978-1979. Most sampling was done in streams with flows of less than 0.3 cubic meters per second, around Puget Sound in western Washington. Altered sections of streams had either been channelized or used by livestock. Channelization significantly reduced the overhead cover, sinuosity, wetted area, and woody bank cover, while increasing bank grasses. The total habitat area declined in altered areas. These impacts seriously damaged the quality of habitat for cutthroat trout over 70 mm in length. Biomass of coho salmon did not significantly decline in altered sections except in severely damaged areas. No loss in habitat quality was noted for zero-aged trout, although larger trout did suffer. Short term effects of machinery operation in one stream did include biomass depletions of all salmonid species and size classes. Channelization and livestock use appeared to reduce quality of winter habitat for salmonids. In altered sections with stable bottoms, no recent damage history, relatively little silt and sand, and adequate riffle areas, the reduction in overhead cover led to higher standing crops of salmonids, suggesting that fish production in many streams of the Puget Sound area may be light-limited. (Baker-FRC)
W81-05121

7. RESOURCES DATA

7A. Network Design

SAMPLING STRATEGIES FOR ESTIMATING THE MAGNITUDE AND IMPORTANCE OF INTERNAL PHOSPHORUS SUPPLIES IN LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W81-05050

LAKE DATA ANALYSIS AND NUTRIENT BUDGET MODELING,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-206039, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/3-81-011, April, 1981. 70 p, 5 Fig, 11 Tab, 68 Ref.

Descriptors: *Lakes, *Water quality, *Mathematical models, *Statistical analysis, Sampling, Data acquisition, *Trophic level, Costs, Prediction, Nutrients.

Several quantitative methods that may be useful for lake trophic quality management planning are discussed and illustrated. The data generated by these methods may be used statistically or in mathematical models. The value of the statistics or models depends on the validity of the methods used to generate the data. A statistical sampling design should be used to obtain accurate data reflecting the trade-off between cost and uncertainty of the acquired data. Data analysis should be undertaken with consideration of the 'vague concept' of interest; graphical analysis is often helpful. The model development data set for any particular model represents a subpopulation of lakes and results may be biased if the model is applied to other lakes. Prediction error on the quality variable of concern may be large if the model does not include all the calculations to link control variables with the quality variable of concern. Selection of a model must consider its applicability to the conditions being studied. These concepts are exemplified using data on lake water quality, nutrient budgets, and trophic quality modeling. (Brambley-SRC)
W81-05055

ANALYSIS OF SURFACE MOISTURE VARIATIONS WITHIN LARGE-FIELD SITES,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W81-05093

A SURVEY OF THE U.S. NATIONAL PRECIPITATION NETWORK.
Stephen F. Austin State Univ., Nacogdoches, TX. Dept. of Forest Hydrology.
M. Chang.
Water Resources Bulletin, Vol 17, No 2, p 241-243, April, 1981. 3 Fig, 11 Ref.

Descriptors: *Weather data collections, *Precipitation, Network design, Data collection, *Rain gages, United States.

This note reports results of an investigation on the availability of National Weather Service (NWS) precipitation records in each state of the United States. The network consisted of 8247 daily and 3036 hourly precipitation gages operated in the conterminous United States at the end of 1975. Except for a few states, mostly in the mountainous west, precipitation stations maintained by the NWS were adequate in numbers to ensure a 95% statistical probability that state sample means will estimate true means within 5%. The patterns of state gage networks appear to be related to the worldwide tendency for gage density to increase with population density. In some states, however, network efficiency might improve if some gages were relocated to better represent precipitation zones. About 70% of the daily stations have records exceeding 25 years, which is adequate for many determinations important to hydrologic problems. (Baker-FRC)
W81-05175

SPACEBORNE IMAGING RADAR: GEOLOGIC AND OCEANOGRAPHIC APPLICATIONS,
Jet Propulsion Lab., Pasadena, CA.
C. Elachi.
Science, Vol 209, No 4461, p 1073-1082, September, 1980. 13 Fig, 26 Ref.

Descriptors: *Remote sensing, *Radar, *Oceanography, Oceans, Water currents, Infrared imagery, Monitoring, Drainage patterns, Waves, Internal waves, Sattellite technology.

Aids to geologic mapping and monitoring of ocean surface patterns realized through spaceborne imaging radar from the Seasat orbiting spacecraft are discussed. The mission was designed to demonstrate the capability of monitoring ocean surface and near-surface features such as surface waves, internal waves, currents, eddies, surface wind, surface topography and ice cover. Drainage patterns were clearly visible and are used to infer variations in the surface lithology. In bedrock areas these patterns depend, for the most part, on the lithologic character of underlying rocks, the attitude of these rock bodies, and the arrangement and spacing of the planes of structural and lithologic weakness encountered by the runoff. In the case of the radar sensor, the drainage patterns are observed because of variation in local slope at the edge of a river segment, variation in vegetation cover, difference in tone due to the different backscatter from the water surface, and strong scattering from the boulders and pebbles in the dry channel bottom in arid regions. (Baker-FRC)
W81-05187

7B. Data Acquisition

AN IMPROVED TECHNIQUE FOR SPATIAL SAMPLING OF SOLUTES IN SHALLOW GROUNDWATER SYSTEMS.
North Central Forest Experiment Station, Rhinelander, WI. Forestry Sciences, Lab.
E. A. Hansen, and A. R. Harris.
Water Resources Research, Vol 16, No 4, p 827-829, August, 1980. 4 Fig, 7 Ref.

Descriptors: *Sampling, *Boreholes, *Solute transport, *Water analysis, Groundwater, Shallow groundwater systems.

A groundwater profile sampler consists of a series of sample probes packed in sand-filled compartments in a 3-cm screened well point. Four layers of 1-mm mesh polyethylene screen retain the sand without plugging. The sampler is installed by driving it to the appropriate depth, usually in 1.5 meter increments. After each 1.5 meter of driving, the installer is removed, another 1.5 meter section of pipe added, and the apparatus reassembled. All samples from a profile sampler are collected simultaneously by vacuum in about 1 minute. Flushing is not necessary prior to collecting a sample. This equipment allows multiple sampling at various depths in a single borehole. The maximum depth in this study was 3 meters, but greater depths can be accommodated. (Cassar-FRC)
W81-05131

THE POTENTIAL OF REMOTELY SENSED THERMAL INFRARED DATA TO INFER SURFACE SOIL MOISTURE AND EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
J. C. Price.
Water Resources Research, Vol 16, No 4, p 787-795, August, 1980. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Satellite technology, *Soil moisture, *Evaporation rate, *Thermal capacity, Remote sensing, Infrared radiation, Moisture profiles, Air temperature, Model studies, Mathematical models.

Recently launched satellites, the Heat Capacity Mapping Mision and Tiros-N, provide high resolution thermal infrared data (10.5-12.5 micrometers) for early morning and early afternoon, good times for measuring daily minimum and maximum temperature. This information was used to derive analytical expressions relating mean evaporation rate and a quantity dependent on soil moisture (diurnal heat capacity) to surface temperature of bare soil areas. The TELL-US model was used to simulate the diurnal cycle of surface temperature under realistic air temperature, humidity, and wind speed conditions, thus refining the analytical expression for micrometeorology effects. Results illustrate the sensitivity of 24-hour mean temperature to mean evaporation rate, and of the day-night temperature range to near-surface soil moisture. Satellite data is potentially useful for assessing the surface moisture budget. (Cassar-FRC)
W81-05132

COMPARISON OF ANNUAL AND PARTIAL DURATION SERIES FLOODS ON THE MURRUMBIDGEE RIVER,
Riverina Coll. of Advanced Education, Wagga Wagga (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W81-05164

PLOTTING FORMULA FOR FLOOD FREQUENCY,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W81-05169

USING A DISTRIBUTED ROUTING RAINFALL-RUNOFF MODEL.
National Space Technology Labs., NSTL Station, MS.; and Geological Survey NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2A.
W81-05173

GENERALIZED SKEW COEFFICIENTS FOR FLOOD FREQUENCY ANALYSIS.
Nevada Univ. System, Reno. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W81-05176

A NEW METHOD FOR ESTIMATING PHYTOPLANKTON GROWTH RATES AND CARBON BIOMASS,
Hawaii Univ., Honolulu. Dept. of Oceanography.
D. G. Redalje, and E. A. Laws.
Marine Biology, Vol 62, No 1, p 73-79, 1981. 1 Fig, 2 Tab, 44 Ref.

Descriptors: *Phytoplankton, *Growth rates, *Chlorophyll a, Biomass, *Estuaries, Eutrophication, Carbon-14.

Phytoplankton growth rates and carbon biomass are determined by C14-labeling the chlorophyll-a pool of phytoplankton exposed to C14-bicarbonate. The chlorophyll-a is isolated by two-dimensional thin-layer chromatography, and the specific activity of chlorophyll-a carbon is determined. Incubation time is 6-12 hours, during which the specific activity of chlorophyll-a carbon becomes nearly equal to that of total phytoplankton carbon. Water from oligotrophic lakes may require much larger samples in order for the chlorophyll-a spot to be discernible on the TLC plate. In addition, physiological damage to the cells must be avoided by using large bottles (4 liter) and short incubation periods (6-12 hours). The ratio of estimated to actual phytoplankton carbon under batch and continuous culture and different nutrient conditions varied from 0.82 to 1.30, mean 1.03. The method was applied to water from Kaneoke Bay, Hawaii, a eutrophic estuary. Doubling time was about two days, and about 85% of the particulate carbon was phytoplankton carbon. Ratios of phytoplankton carbon to chlorophyll-a were 242 and 272, high when compared with commonly assumed ratios of 50-100. (Cassar-FRC)
W81-05182

SPACEBORNE IMAGING RADAR: GEOLOGIC AND OCEANOGRAPHIC APPLICATIONS,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 7A.
W81-05187

PRECIPITATION CHEMISTRY PATTERNS: A TWO-NETWORK DATA SET,
For primary bibliographic entry see Field 2B.
W81-05219

AN EVALUATION OF AN UNATTENDED CURRENT AND TEMPERATURE PROFILER FOR DEEP LAKES,
National Water Research Inst., Burlington (Ontario).
P. F. Hamblin, and R. Kuehnel.
Limnology and Oceanography, Vol 25, No 6, p 1128-1141, November, 1980. 10 Fig, 1 Tab, 5 Ref.

Descriptors: *Instrumentation, *Temperature, *Velocity, Deep water, Current meters, Water circulation, Measurement, *Lakes, *Water currents.

Horizontal currents and temperature were measured in a deep lake by an unattended (for 6 days) apparatus capable of high vertical resolution. Current is measured by a sensitive probe converted to a shore-based depth control assembly. A complete profile is taken during ascent at a rate of 2.5 cm per sec. The probe is based on differences in the time of flight of acoustic pulses. A reference velocity for the sensor was established from both laboratory and field data. The care required to calibrate the equipment is outweighed by its ability to detect weak flows not sensed by faster moving conventional mechanical devices. Currents as low as 2 cm per sec may be detected with a resolution of plus or minus 2 cm per sec rms. Some data gathered from measurements in Kootenay Lake, British Columbia, showed temporal variability in velocity structure over a daily period. In the autumn profiles flow reversed suddenly at all depths, probably as a result of internal seiches. In spring, storm events were readily noted in current variations. Velocity varied frequently when temperature did not. (Cassar-FRC)
W81-05225

A NITROGEN POWERED CONTINUOUS DELIVERY, ALL-GLASS-TEFLON PUMPING SYSTEM FOR GROUND-WATER SAMPLING FROM BELOW 10 METERS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
M. B. Tomson, S. Hutchins, J. M. King, and C. H. Ward.
Ground Water, Vol 18, No 5, p 444-446, September-October, 1980. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Sampling, *Pumps, *Water analysis, Organic compounds, *Pollutant identification, Groundwater, Water quality.

A nitrogen powered, non-contaminating groundwater sampling pump system for depths below 10 meters is constructed of glass and Teflon. Flow rates up to 45 gal per hour are obtainable. This system was field tested in a study of trace level organic compounds using resins (activated carbon is also usable) to concentrate the contaminants. The apparatus is also applicable to marine, lake or other water and fluid systems and can be extended to any inorganic or microbial assay where an unaltered sample is desired. (Cassar-FRC)
W81-05228

AN OPTO-ELECTRONIC SEDIMENT DETECTOR AND ITS USE IN THE CHEMICAL MICRO-PROFILING OF LAKES,
Freshwater Biological Association, Ambleside (England).
C. R. Cunningham, and W. Davison.
Freshwater Biology, Vol 10, No 5, p 413-418, October, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Lakes, *Sediment sampler, Measuring instruments, Sedimentation, Chemical composition, *Sediment water interfaces.

A device for detecting the sediment-water interface in lakes is described. The sediment detector is based on a slotted opto-switch intended for event counting, tape reading and similar applications. The opto-switch uses an infra-red light emitting diode of peak wavelength 940 nm, shining on a phototransistor. Interruption of the light beam causes the collector voltage of the photo-transistor to rise and hence switch the Schmitt triggers formed by comparators one and two, resulting in a liquid crystal display, triggering the monostable multivibrator and switching on the audible warning device for 0.1 seconds. A small alkaline battery will last up to 30 hours in the system depending on the number of times the bleeper is activated. The device was used to obtain microprofiling data of lake water in Esthwaite Lake, a very productive lake. The trials in this lake have indicated that the sediment detector can aid in the reproducible collection of samples at a known distance from the bottom of the lake. (Baker-FRC)
W81-05229

GROUNDWATER MODELING: APPLICATIONS,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 2F.
W81-05235

STUDYING THE GROUND WATER FLOW CONDITIONS,
H. Wihuri, and E. Malkki.
Aqua, No 4, p 90-91, April, 1980. 5 Fig.

Descriptors: *Tracers, *Flow measurement, *Flow velocity, Alluvium, Measuring instruments, *Groundwater movement, Carbon, Velocity, Permeability.

Colloidal carbon black was used in a tracer dilution method for determining groundwater velocity. The measuring instrument, usable with either colorimetric or electrolytic tracers, permits an average of 30 measurements a day (10-20 minutes each). It consists of a probe inserted into a test tube or borehole, a source of light, and photocells to transmit measurements to the surface. New samples may be injected into the apparatus without removing the probe from the borehole or tube. Several advantages are noted. No errors from tracer diffusion, density differences, or osmotic circulation occur. The empirical calibration of the instrument simulates the conditions in the measuring tube. The tracer dilution rate can be converted into groundwater flow velocity. The procedure can be used under nonlaminar flow conditions. Possible errors may result from vertical flow, compaction of strata, and soil washout during flushing. Accuracy is + or - 20%, with occasional deviations as high as + or - 50%. The main area of use is in sand and gravel alluvium. (Cassar-FRC)
W81-05247

ELECTRONICS MONITOR ALBUQUERQUE WELLS.
American City and County, Vol 96, No 4, p 77, April, 1981. 1 Fig.

Descriptors: *Well data, *Monitoring, *Drawdown, Water table, Aquifers, Piezometers, Water level fluctuations, Electronic equipment, Pumping, New Mexico, *Albuquerque, Water pressure.

Rapidly increasing water demand and expanding investments in well drilling and associated costs in Albuquerue, New Mexico, have increased the importance of accurate measurements of water levels. Both static and drawdown levels must be monitored to assure that water is not mined beyond the point of natural recovery by recharge and to protect well equipment. Solid state transducers are being used as submersible pressure sensors to measure water levels directly in a real time mode. Operating experience has shown that a single transducer suspended by aircraft cable is sufficient to provide needed reliability and accuracy. The submerged sensor uses a piezoresistive silicon chip with an integral Wheatstone Bridge circuit to measure wastewater pressure in the water column. The resulting signal is transmitted to the surface for display at a central control point. (Carroll-FRC)
W81-05250

USE OF LANDSAT DATA TO IMPROVE THE WATER BUDGET COMPUTATION IN LAKE OKEECHOBEE, FLORIDA,
Agricultural Research and Education Center, Belle Glade, FL.
S. F. Shih.
Journal of Hydrology, Vol 48, No 3/4, p 237-249, November, 1980. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Lakes, *Hydrologic budget, *Prediction, Satellite technology, Lake stage, *Lake Okeechobee, Florida, Water storage, Water depth, Vegetation, Aquatic plants, Littoral zone, Evapotranspiration, Data acquisition, Statistical analysis.

Lake Okeechobee, which is one of the few freshwater lakes in the semitropics and one of the largest lakes in the United States, serves as the major storage basin for surface water in southern Florida. Evaluation of the lake's storage volume is important in water use and in water development and management. The South Florida Water Management District used the water budget model to provide quantitative information for many proposed management schemes. However, the results of the application of this model were found to be seriously in error. In order to improve the prediction of the Lake's storage capacity and water surface area as related to lake stage, a technique was applied which involved analysis of the digital data from the LANDSAT earth satellite on a multispectral image analyzer. The resultant multispectral classification of the vegetation in the lake's littoral zone was used to provide a data base for determination of the surface area occuppied by each vegetation community as related to the lake storage. Comparison of several techniques showed that the water budget model which combined LANDSAT data analysis with the marsh zone evapotranspiration method provided the most accurate computation of the water budget for the lake. Use of this computation method reduced the sum of storage deviation during the period 1963 through 1974 from the original 77 percent to only 5 percent overestimation of the lake volume. (Carroll-FRC)
W81-05255

FIELD OBSERVATIONS AND FLUME EXPERIMENTS ON THE NATURE OF COMET MARKS.
Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
F. Werner, G. Unsold, B. Koopmann, and A. Stefanon.
Sedimentary Geology, Vol 26, No 1/3, p 233-262, April, 1980. 10 Fig. 1 Tab. 37 Ref.

Descriptors: *Sedimentary structures, *Bottom currents, Comet marks, Sonar, Sand, Sand waves, *Flumes, Sediments, Erosion.

Close-up observations of the geometry and composition of so-called comet marks were made and interpreted in the light of experimental results in respect to flow conditons. Comet marks are defined as obstacle-induced, long erosional strips occurring on current-affected sea bottoms. Field observations and flume experiment suggest that comet marks can be considered as indicators of flow conditions acting on sea bottom. For a starved condition of sand supply, comet marks are developing as parabolic types with little relationship between their morphology and current velocity. For conditions of moving ripple beds, a morphological grouping can be related to the flow conditons. Spindle-like forms of different relative tail lengths coexist with small-scale ripples and refer to relative flow velocities between those characterizing the start of sedient transport and those characterizing the upper limit of small-scale ripple stability. Comet marks with quasi-infinite tail lengths occur above the threshold velocity of ripple stability. Transition between this type and sand ribbons shows that the generation of sand ribbons may be related to similar flow conditions. Crescent- and horseshoe-shaped obstacle scours are characteristic of low-velocity currents if found on noncohesive sediments. On cohesive sediments their diagnostic value is poor due to lack of knowledge on the conditions of erosion of these sediments. (Baker-FRC)
W81-05268

VERTICAL DISTRIBUTION OF INVERTEBRATE DRIFT IN A LARGE RIVER,
Saint Cloud State Univ., MN. Dept. of Biological Sciences.
W. J. Matter, and A. J. Hopwood.
Limnology and Oceanography, Vol 25, No 6, p 1117-1121, November, 1980. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Invertebrates, *Distribution patterns, *Sampling, Mayflies, Caddisflies, Rivers, Nets, Vertical distribution.

Invertebrate drift in the Mississippi River was not uniform in the vertical water column, as has been assumed in past studies. Using a new multilevel sampling apparatus capable of sampling in water exceeding 0.5 meters depth, densities of mayflies (Pseudocloeon and Baetis) and caddisflies (Hydropsyche and Cheumatopsyche) at depths from 0.44 to 1.29 meters were determined. A large variation was seen in the invertebrate densities in the top, middle, and bottom sections of the collection nets. The mayfly group showed a general tendency to accumulate in the top sections both night and day; the caddisfly group showed a tendency to be caught in the lowest section of the net. (Cassar-FRC)
W81-05282

A NEW SAMPLER FOR STREAM BENTHOS, EPIPHYTIC MACROFAUNA AND AQUATIC MACROPHYTES,
Reading Univ. (England). Dept. of Zoology.
P. D. Hiley, J. F. Wright, and A. D. Berrie.
Freshwater Biology, Vol 11, No 1, p 79-85, 1981. 1 Fig, 4 Tab, 7 Ref.

Descriptors: *Benthos, *Stream biota, *Biological sampling, Sampling techniques, Invertebrates, Macroinvertebrates, Macrophytes, Biomass, Population density, Rivers.

In pursuing a project to investigate the ecology of the River Lambourn in Berkshire, Great Britain, it soon became evident that no single sampler available at that time could fulfill the requirements of the proposed research program. Tests of several samplers and procedures showed that none were capable of taking reliable samples consistently when used in this river on the five major biotopes. As a result, the Lambourn sampler was designed to overcome a number of the limitations of the existing devices. This sampler combines the advantages of the box sampler and the Surber sampler. The sample area is 200 by 250 millimeters (0.05 square meters) and the device can be used to sample the benthos of rivers to a depth of about 60 millimeters where the substratum consists of particles with diameters of 50 millimeters or less. The sampler may be used in water up to 0.5 meter in depth. An optional top unit may be used to increase the allowable depth to 1.0 meter. The Lambourn sample is capable of documenting the biomass of macrophytes and the biomass and density of invertebrates on the study sites at all seasons of the year with acceptable precision. Aquatic macrophytes can be sampled either separately or together with the underlying substratum. (Carroll-FRC)
W81-05285

TOLERANCE OF HEADWATER VS. MAINSTREAM FISHERS FOR ABRUPT PHYSICOCHEMICAL CHANGES,
Roanoke Coll., Salem, VA. Dept. of Biology.
W. J. Matthews, and J. T. Styron, Jr.
American Midland Naturalist, Vol 105, No 1, p 149-158, January, 1981. 3 Tab, 53 Ref.

Descriptors: *Fish, *Tolerance, *Environmental effects, *Headwaters, Streams, *Downstream, Roanoke River, Cyprinid, Dater, Upstream, Physicochemical properties, Comparison studies.

The hypothesis that fish species of intermittent headwaters are more tolerant of abrupt physicochemical change than are species which are restricted to mainstreams was tested using a headwater cyprinid (Phoxinus oreas) of the Roanoke River drainage in comparison with three mainstream cyprinids (Notropis ardens, N. albeolus and N. cerasinus). The possibility of interspecies differences in oxygen tolerance between headwater and mainstream populations of the widely distributed Etheostoma flabellare was also studied. In all of the interpsecific comparisons made it was determined that headwater species were more tolerant than species restricted to the more environmentally stable mainstream. Physicochemical tolerances of fishes appear to correlate with the upstream limits of their distributions in small watersheds and thus may relate directly to the pattern of longitudinal zonation of species that is observed in many stream systems. (Baker-FRC)
W81-05302

A SYSTEM FOR AUTOMATICALLY MEASURING AND RECORDING SOIL WATER POTENTIAL AND RAINFALL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
For primary bibliographic entry see Field 2G.
W81-05305

SAND TRANSPORT AND BEDFORM PATTERNS ON THE CONTINENTAL SHELF BETWEEN DURBAN AND PORT ELIZABETH (SOUTHEAST AFRICAN CONTINENTAL MARGIN),
Institute of Oceanology, Rondebosch (South Africa).
B. W. Flemming.
Sedimentary Geology, Vol 26, No 1/3, p 179-205, April, 1980. 20 Fig, 50 Ref.

Descriptors: *Sedimentary structures, Seismic properties, Seismographs, Seismology, *Sediment transport, Geophysics, *Sonar, Cameras, *Bottom currents, Sand, Sand waves, Continental shelf, Continental margin, *South Africa.

In three 10-day cruises, undertaken at 5-month intervals, a regional side-scan sonar survey was completed on the shelf between Durban and Port Elizabeth. These investigations provided a sound basis for detailed investigations of the sediment dynamics in this western boundary current system. A total distance of 5600 kilometers was surveyed. Three distinct shore-parallel zones were distinguished. Each zone reflected a specific wave- or current-controlled regime. The nearshore zone consists of a sediment wedge of variable thickness, is wave-dominated, and does not reveal current-generated bedforms. The central shelf consists of a sandstream reaching five kilometers wide in the north and widening to over 20 kilometers in the south, characterized by a multitude of current-generated longitudinal and transverse bedforms. The outer shelf is situated at the high-velocity margin of the Agulhas Current and consists of a sand-depleted gravel pavement. Two major mechanisms of sediment supply were identified. One diffuses small quantities of sand across the wave/current boundary over a broad front. The other passes sand by means of a constructional/destructional cycle along the outer edge of the nearshore sediment wedge in response to lateral migration and meandering of the Agulhas Current. Individual bedforms include sand ribbons, comet marks, sand streamers, dunes, and smooth sand sheets. (Baker-FRC)
W81-05323

7C. Evaluation, Processing and Publication

PRELIMINARY MAP SHOWING FRESHWATER HEADS FOR THE MISSION CANYON AND LODGEPOLE LIMESTONES AND EQUIVALENT ROCKS OF MISSISSIPPIAN AGE IN THE NORTHERN GREAT PLAINS OF MONTANA,
Geological Survey, Billings, MT.
For primary bibliographic entry see Field 2F.
W81-05008

PRELIMINARY MAP SHOWING FRESHWATER HEADS FOR THE RED RIVER FORMATION, BIGHORN DOLOMITE, AND EQUIVALENT ROCKS OF ORDOVICIAN AGE IN THE NORTHERN GREAT PLAINS OF MONTANA, NORTH AND SOUTH DAKOTA, AND WYOMING,
Geological Survey, Billings, MT.
For primary bibliographic entry see Field 2F.
W81-05009

DISSOLVED-SOLIDS AND RATIO MAPS OF WATER IN THE MADISON GROUP, MONTANA,
Geological Survey, Billings, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05015

FLOOD-PLAIN AREAS OF THE MISSISSIPPI RIVER, MILE 866.8 TO MILE 888.0, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W81-05018

***GROUND-WATER HYDROLOGY OF THE* LITTLE KANAWHA RIVER BASIN, WEST VIRGINIA.**
West Virginia Geological and Economic Survey, Morgantown. Water Research Div.
For primary bibliographic entry see Field 2F.
W81-05020

FRESH AND SALINE GROUND-WATER MAP OF WEST VIRGINIA,
Illinois State Geological Survey, Urbana. Water Resources Div.
J. B. Foster.
West Virginia Geological and Economic Survey, Morgantown, Map WV-12, 1980. 4 Sheets, 2 Maps.

Descriptors: *Maps, *Groundwater, *Saline water, *Saline-freshwater interfaces, Elevation, Contours, Water pollution sources, Contamination, Encroachment, Well data, Oil wells, *West Virginia.

Two ground-water maps of West Virginia (scale 1:250000) show the elevation of the base of freshwater and the elevation of the top of saline water. Elevations of the base of freshwater taken from water-well logs provided a control by which freshwater data were selected from oil-and-gas well logs. Of about 40,000 oil-and-gas well logs on file, approximately 1,500 contained depths to saline water useful in compiling this map. The data, selected randomly by areal distribution, were processed by a computer program which generated an array of equally-spaced computed values (nodes). The array of data values provided the basis upon which a computer-contouring program generated these maps. The authors emphasize that data density varies tremendously across the State and that the data array and the contours were generated from machine programing; consequently, the contours represent the averaged values of nearby data points at array nodes. Therefore, the accuracy of the map is influenced by the contouring procedure used. Although in some instances actual data points may have been violated by the contouring program, it is estimated that the contours are generally accurate to within one-half contour interval in areas where adequate control exists. The inset map shows the thickness of the zone between the base of freshwater and the top of saline water. This map was prepared by a computer program that subtracted the data array representing the top of saline water from the array representing the base of freshwater, and contoured the difference. The shaded areas show where the two zones interface naturally or where there is saline-water encroachment. The accuracy of the inset map is estimated to be one-half contour interval. (USGS)
W81-05021

GROUND-WATER LEVELS IN SELECTED WELL FIELDS AND IN WEST-CENTRAL FLORIDA, MAY 1980,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05022

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1980,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05024

USE OF CHLOROPHYLL-SECCHI DISK RELATIONSHIPS,
Tetra Tech, Inc., Bellevue, WA.
M. W. Lorenzen.
Limnology and Oceanography, Vol 25, No 2, p 371-372, March, 1980. 2 Fig, 5 Ref.

Descriptors: *Secchi disks, *Light penetration, *Lakes, *Chlorophyll, Phytoplankton, Extinction coefficient, Turbidity, Limnology, Water quality, Physical properties, Algae.

Several workers have proposed the use of changes in chlorophyll a levels to predict changes in water transparency as measured by the Secchi disk. These relationships imply that changes in concentration at low phytoplankton levels would produce large changes in transparency, which is not necessarily true in practice. At high chlorophyll concentrations the extinction coefficient (non-chlorophyll light absorption) is the controlling factor; at low chlorophyll concentrations other light absorption factors are the controlling factors. The importance of the extinction coefficient in these relationships is emphasized. Since lakes differ in turbidity and color, it is necessary to include this factor in calculations. The extinction coefficient should be determined for each lake under study and the effects of changed chlorophyll on transparency estimated from a family of curves presented in the paper. (Cassar-FRC)
W81-05200

COMPUTER MODELS IN GROUND-WATER EXPLORATION,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 2F.
W81-05231

8. ENGINEERING WORKS

8A. Structures

HYDRAULIC MODEL STUDIES OF MCPHEE DAM SPILLWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Report GR-81-2, March, 1981. 56 p, 26 Fig, 2 Tab, 5 Ref.

Descriptors: *Hydraulic design, *Spillways, *Stilling basins, *Flood discharge, Model studies, Channel erosion, Floods, Dams, Flow discharge, Jets, Hydraulic jump, McPhee Dam, Colorado.

A 1:36 scale model was used to develop the hydraulic design of the spillway for McPhee Dam located on the Dolores River in southwestern Colorado. Possible modifications to minimize downstream channel erosion, and optimize flow conditions in the approach channel were investigated. The model included the approach channel, spillway crest and radial gates, spillway chute, combination stilling basin - flip bucket, and exit channel. The 18.3 m wide by 303 m long chute spillway is designed for a maximum discharge of 940 cu m/s. Ordinarily, energy is dissipated in a hydraulic jump. For large floods, the flow will sweepout of the stilling basin into the exit channel. Model studies included investigation of approach flow conditions, pressures and flow distribution in the chute spillway, flow characteristics with the combination stilling basin-flip bucket, and flow conditions and erosion in the exit channel. Four flip bucket configurations were tested. In the final design, the radius of the flip bucket was shorter and the lip elevation higher than in the original design. These changes helped stabilize the hydraulic jump and clear the jet impact away from the basin after sweepout with a minimum amount of damage to the downstream channel. The discharge channel was deepened and widened to dissipate the energy of the jet striking the tailwater after sweepout. The initial sweepout flow is 465 cu m/s, as compared to the 100-year flood of 375 cu m/s. The outlet works can pass an additional 145 cu m/s. A spillway flow of 200 cu m/s is required to wash 75 mm diameter rocks out of the stilling basin. (Moore-SRC)
W81-05037

RISK OF DAM FAILURE IN BENEFIT-COST ANALYSIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
G. B. Baecher, M. E. Pate, and R. de Neufville.
Water Resources Research, Vol 16, No 3, p 449-456, June, 1980. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Dams, *Cost-benefit analysis, Risks, Economic aspects, Mathematical studies, Dam failure, *Dam design.

A method is presented by which the cost of failure of a dam can be calculated, and this cost can then be incorporated into the evaluation process. The procedure for incorporating the risk costs of failure into the evaluation of dams is straightforward, following classical lines, deriving its novelty from

the application to the pecularities of dams and from the identification of a plausible default value for their probability of failure. One critical issue is what the probability of failure should be; given that research will not provide accurate values for some time, a default value of 10 -4/dam year is proposed to be used until better information can be obtained. Another issue is whether the refinement of incorporating risk costs is worthwhile. In this case the risk-benefit factor is introduced to be used as a screening tool for deciding this question. The importance of the implicit value ascribed to lives lost through failure is considered. (Baker-FRC)
W81-05119

FLOW AERATION TO PREVENT CAVITATION EROSION,
Hidrotecnica Portuguesa, Lisbon. Hydraulic Structures Div.
A. C. Quintela.
International Water Power and Dam Construction, Vol 32, No 1, p 17-22, January, 1980. 9 Fig, 17 Ref.

Descriptors: *Spillways, *Flow, *Aeration, *Dam design, Erosion control, Structural models, Design criteria.

The latest procedures in the use of flow aeration to prevent cavitation erosion are described, and various applications are discussed. Aeration of high-velocity flows is a successful and inexpensive method of preventing cavitation erosion caused by surface irregularities. An aeration device can create air beneath the flow. As air is entrained by the flow, pressure in the space becomes lower than atmospheric pressure, allowing air from the atmosphere to penetrate naturally into that space and afterwards, be entrained by water. Model tests based on Froude's law indicate, for instance, that air discharge is 0.25 to 0.2 times the value measured on the prototype in the Nurek spillway model. Model tests can give an accurate configuration of the flow near the aeration device and of the air space under the jet. When air grooves are used, the cross-sectional dimensions of each groove should be a minimum of 0.30 sq m. Important new applications include the spillways at the Karakaya and Toktogul dams. (Small-FRC)
W81-05201

DESIGNING THE PROFILE OF GRAVITY DAMS,
MECCO Ltd., Dar-es-Salaam (Tanzania).
C. S. Joshi.
International Water Power and Dam Construction, Vol 32, No 1, p 28-30, January, 1980. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Gravity dams, *Dam design, *Slopes, Design criteria, Graphic analysis, Computer programs.

A method is described for finding the most technically and economically appropriate upstream and downstream slopes for a gravity dam. Equations are presented which can be solved using a calculator or computer program. First, the various dam parameters are decided, including: dam material density, design head, silt height, etc. The level at which the downstream slope will start is found, and the level at which the upstream slope should be started is also determined. Two second-degree equations are formulated to satisfy two conditions of no tension on the upstream and downstream faces. Two graphs of slope values are obtained for a given design of head water, each meeting a different condition. The point of intersection of the two curves is the first point at which the value will satisfy both the conditions of no tension criteria simultaneously, and will have the least cross-sectional area. Computer programs for the method (DEC 10) are available from the author. (Small-FRC)
W81-05202

LOCATION OF UNDERGROUND LEAKS USING THE LEAK NOISE CORRELATOR,
D. B. Field.
Aqua, No 7, p 21-22, 1980. 5 Fig.

Descriptors: *Leakage, *Pipelines, *Measuring instruments, Noise, Sounding, Water distribution, Water supply systems.

The Leak Noise Correlator overcomes many problems inherent in the surface sounding method of detecting water distribution system leaks. This commercially available instrument located 77% of 65 leaks within 1 meter of the actual location and 94% within 2 meters. Maximum time taken for location of a leak was 2 hours. A technique known as cross-correlation uses signals received from 2 points and the difference in travel time to produce a peak on a chart. Noise from traffic or pumps is not a problem. (Cassar-FRC)
W81-05241

DIRTY PIPES ARE 'ENERGY EATERS',
M. Landes.
American City and County, Vol 96, No 4, p 67-68, April, 1981. 1 Fig.

Descriptors: *Pipe flow, *Sewer systems, *Cleaning, Water transport, *Maintenance, Conveyance structures, Energy conservation, Cost analysis, *Economic efficiency.

A clean pipeline is essential to the delivery of potable water in an economical manner. The internal pipe surface plays a major role in the determination of pumping costs through pipelines. Laminar flow can be greatly affected by relatively small buildups. In one case, a one-quarter inch thick deposit on a 36-inch pipe reduced flow by 50 percent. Pigging appears to be the fastest and most economical means to maintain pipeline cleanliness. Pipeliners must select the pig that will best serve their particular needs from among the cup pigs, disc pigs, mechanical scrapers, spheres, and rubber foam pigs available. The pig unit should be selected on the basis of effectiveness, dependability, economy, and convenience. Several examples of dramatic energy savings and flow increases resulting from pigging pipelines are presented. Rubber foam pigging of 1000 feet of 12-inch pipe and 11,000 feet of 8-inch pipe resulted in savings of 1580 kilowatt hours per day for a Canadian chemical company. The City of Savannah was able to increase the pipeline flow 'C' factor from 78 to 83 before cleaning to 125 to 131 after cleaning 40,000 feet of 48-inch pipe, resulting in a savings of about $125 per day in energy costs. (Carroll-FRC)
W81-05251

DESIGN CRITERIA FOR FLOATING TIRE BREAKWATERS (CLOSURE),
California Univ., Berkeley. Lawrence Berkeley Lab.
V. W. Harms.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW1, p 29-34, February, 1981. 33 Fig.

Descriptors: *Breakwaters, *Design criteria, *Mathematical models, Sea walls, Jetties, Water depth, Deep water, Shallow water, Tire flotation.

A discussion of design criteria for floating tire breakwaters includes the suggestion that semi-empirical wave transmission relationships be extended to include the influence of relative draft. Originally, the expression was based on deep water wave conditions, and the influence of water depth was not accounted for. Sufficient experimental data on the influence of water depth did not exist. For two tire breakwaters, the Goodyear Breakwater and the Pipe Tire Breakwater, the water depth parameter was found to be increasingly important as water depth decreased and as the longitudinal rigidity of the breakwater increased. For the Goodyear Breakwater, the parameter increased from 0.16 to 0.33. For the P-T Breakwater, the parameter increased from 0.22 to 0.51. (See W79-07316). (Small-FRC)
W81-05321

SOME CHARACTERISTICS OF RIVER BED WATER INTAKES,
B. B. Willetts.
Aqua, No 6, p 115-117, 1980. 4 Fig, 1 Ref.

Descriptors: *Intakes, *River beds, Backwash, Water supply systems, Water conveyance, Ice formation, Sediment transport, Erosion, Deveron River, Scotland.

A river bed intake with negligible effect on fish life is described. It consists of an open-topped chamber under the river bed, partially filled with gravel and rock. Pumping removes the water at a constant rate, 27,000 cu meters per day in the River Deveron, Scotland. Often several compartments are contained in one intake, so that any one may be backwashed, shut down, or operated at a different flow rate. Disturbances of the river flow generally produce a dune downstream of the intake. Surface debris or floating liquid contaminants and active bed load transport do not affect intake operation. The apparatus does not interfere with scenery. However, rivers with considerable suspended load quickly block the intakes and form dunes which may interfere with flow. The backwashing procedure also has problems. In fast flowing rivers where ice growth forms on nucleating particles, the bed performance is greatly reduced both during the icing season and afterwards because a blanket of gravel is deposited on the intake. (Cassar-FRC)
W81-05332

THE CITY OF ATHENS' WATER SUPPLY SCHEME,
Societe du Canal de Provence det d'Amenagement de la Region Provencale le Tholonet, Aix-en Provence (France).
J. Lefebvre, and R-J. Chauvet.
Aqua, No 6, p 14-15, 17-19, 1980. 2 Fig.

Descriptors: *Water conveyance, *Canal construction, *Siphons, *Tunnel construction, *Athens, Greece, Mountains, Construction, Mornos Dam, Remote control, Water supply.

A new water supply scheme for Athens, Greece, population three million, was inaugurated November 8, 1979. An important feature is the Mornos Dam, built 150 km west of the city and connected to a new water treatment plant in northern Athens. The conveyance structure covers 188 km and runs through two very mountainous zones and a clayey plain. There are 70,840 meters of tunnels, 7,080 meters of large siphons, 66,150 meters of reinforced rectangular canals, and 44,030 meters of standard trapeze shaped canals. The dynamic regulation system safely controls the water conveyance operation. It consists of a computerized central water management procedure with remote control loop network and remote controlled monitoring devices. (Cassar-FRC)
W81-05350

8B. Hydraulics

IMPINGING JETS,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
R. L. George.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-227902, Price codes: A02 in paper copy, A01 in microfiche. Report REC-ERC-80-8, December, 1980. 17 p, 11 Fig, 2 Tab, 9 Ref.

Descriptors: *Jets, *Energy dissipation, *Hydraulic models, *Plunge basins, Model studies, Hydraulic design, Tailwater, Stilling basins, Basins.

A plunge basin can provide a simple, economical method of dissipating the energy from falling jets. The jet enters the pool and its energy is dissipated by shearing action with the surrounding water and with the boundaries of the basin. The forces created by the jets must be known so that structures can be designed properly to withstand these forces. These forces depend on the total head available, the tailwater depth, the angle of entry into the basin, the size and shape of the basin, and the compactness of the jet. Results of several small-scale model studies with and without water cush-

ions were studied. Pressures at the boundaries of a basin were equal to the full stagnation pressure if the depth of the cushion was less than the depth of flow establishment. Beyond this depth boundary, pressures decrease rapidly as the depth of the water cushion increases. Most of the studies also show that the pressure decays nearly exponentially as the radial distance from the point of impact increases. Several of the empirical criteria are summarized and compared with results from laboratory model tests. The comparison shows that the criteria selected give similar values to the results of the model tests. (Moore-SRC)
W81-05041

WAVE FORCES ON RIGID PIPES USING OCEAN TEST DATA,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
R. A. Grace, and G. T. Y. Zee.

Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW2, p 71-92, May, 1981. 8 Fig, 15 Tab, 14 Ref.

Descriptors: *Wave action, *Pipes, *Ocean waves, Flow, Conveyance structures, Experimental data, Wave velocity, Hydraulic design, *Hawaii, Coastal waters.

A four-year experiment was conducted in Hawaiian waters to examine the effects of wave forces on a test pipe mounted on the sea floor in 37 ft of water. There were four separate angles between the wave fronts and the pipe: 0 deg, 15 deg, 35 deg, and 52 deg. Measurements were made of the wave-induced water motion near the test structure and of horizontal and vertical forces on an instrumented portion of the test pipe. Information was derived on horizontal inertia coefficients using instantaneous force values at times of zero velocity. These were found to correspond closely with ideal flow predictions. Peak forces are the primary concern of this phase of the study, and maximum force coefficients were obtained by normalizing peak forces as for drag coefficients. Effects of changes in the wave-pipe angle and period parameter on the horizontal and vertical maximum force coefficients were examined for both mean-value and extreme-value forms of the data. Also, a simulated submarine pipe design problem is presented which applies the experimental results. (Small-FRC)
W81-05095

VARIATION OF KARMAN CONSTANT IN SEDIMENT-LADEN FLOW,

Tianjin Univ. (China). Dept. of Hydraulic Engineering.
S. Wang.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY4, p 407-417, April, 1981. 5 Fig, 1 Tab, 17 Ref.

Descriptors: Channel flow, *Sediment load, *Mathematical studies, Energy, Flow, Hydrology, *Open-channel flow, Sediment transport.

A formula was derived for calculating the Karman constant in the region of main flow in an open channel carrying a sediment load. The formula is based on the energy balance in a movable bed model without suspended load and on the principles of effective power of suspended load. The equation is verified reasonably well with some field and laboratory data. The bottom regime of stream flow had a greater influence on the Karman constant than did the characteristics of the suspended load. The standard deviation of the formula is plus or minus 0.025. (Small-FRC)
W81-05238

MUSKINGUM METHOD REVISITED,

Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
W. Strupczewski, and Z. Kundzewicz.

Journal of Hydrology, Vol 48, No 3/4, p 327-342, November, 1980. 6 Fig, 10 Ref.

Descriptors: *Open-channel flow, *Mathematical studies, *Hydrodynamics, Mathematical equations, Mathematical models, Flow characteristics.

The Muskingum method is one of the most popular approaches to the mathematical description of the process of open-channel flow. The method, which belongs to the class of two-parameter linear conceptual models, can be developed by means of a crude simplification of hydrodynamic equations of flow. This paper examines the interpretation of the nature and the range of variability of the parameter x of the Muskingum model. The study utilizes a systems approach; matching impulse responses of the Muskingum model and of the linear dynamic wave model; and analysis of the nonlinear storage equation developed for uniform channels with rectangular cross-section under assumption of (1) a common looped rating curve for both input and output from the reach and (2) linear changes of water table along the reach. The range of variability of the parameter x has been proved to extend from infinity to 0.5. The dependence of this parameter upon the physical characteristics of the systems and flow variables has been examined. A determination has been made of the length of the characteristic reach for the Muskingum method and the corresponding range of values of the parameter x. The effect of the influence of the delay existing in the physical system upon the value of the parameter x has been examined. An analysis of the dependence of parameters of the Muskingum method upon the inflow and outflow rate has been performed based on the nonlinear storage equation. (Carroll-FRC)
W81-05254

HYDRAULICS OF CHANNELS WITH FLOOD-PLAINS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and R. Ahmadi.

Journal of Hydraulic Research, Vol 19, No 1, p 43-60, 1981. 12 Fig, 1 Tab, 21 Ref.

Descriptors: *Flow channels, *Flood plains, *River flow, Shear stress, Flow characteristics, Hydraulics, Hydraulic properties, Mathematical equations.

When the depth of flow in rivers with flood-plains exceeds the depth of the main channel, the flood-plains carry a part of the total discharge. The results of a previous exploratory study of the effects of the interaction between the flow in the main channel and the flood-plain were limited because of the narrowness of the channel studied. The present study extends the previous research by removing the restriction on width, presenting the general structure of the flow and its characteristics in a form applicable to the analysis of simple practical flows, and considering the nature of the mixing region between the main channel and the flood-plain and the effects exerted by the bed of the flood-plain on the mixing region. The interaction has been studied for the condition in which the main channel is wide enough to have at least a narrow width in its middle in which the flow is not affected to any noticeable extent by the momentum transfer to the flood-plain. The region affected by the interaction between the flow in the main channel and that in the flood-plain has been shown to resemble a shear layer, with some control exercised by the bed shear stress. The length scales of the interaction region, as well as the reduction and increase in bed shear stress in the main channel and in the flood-plain, respectively, in dimensionless forms, have been correlated with the ratio of the flow depths in the main channel and in the flood-plain. While the mixing layer located on the flood-plain appears to be more complicated than the shear layer between two deep, uniform streams of different velocities, the mixing region located in the main channel appears to possess a somewhat simpler structure, at least over part of its width. (Carroll-FRC)
W81-05259

UNSTABLE TURBULENT FLOW IN OPEN CHANNELS.

Louvain Univ. (Belgium). Dept. of Civil Engineering.
J. E. Berlamont, and N. Vanderstappen.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY4, p 427-449, April, 1981. 12 Fig, 22 Ref.

Descriptors: *Turbulent flow, *Channel flow, *Froude number, Reynolds number, Mathematical studies, Experimental data, Hydrology.

In the determination of the friction factor for turbulent flow in rectangular open channels, some engineers feel that the Froude number affects the value of the friction factor, which others feel it may not be an important parameter after all. Here, the critical Froude number was theoretically derived. Given a value of the Reynolds number, the flow for the Froude number above the critical value became unstable with the appearance of roll waves. The instability of the Froude number in the White-Colebrook friction formula was a function of the shape of the velocity profile, the Reynolds number and the relative channel roughness, the wave length of the initial disturbance wave, and the channel width. Using the formula by Rouse, the influence of the Froude number on the value of the friction factor for unstable turbulent flow in both smooth and rough channels can be calculated. The coefficients in this formula are functions of the channel width. Thus, engineers using wide channels in previous studies did not appreciate the influence of the Froude number. (Small-FRC)
W81-05262

PERFORMANCE OF BAFFLED CHUTE WITH 90 DEGREE BEND.

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. T. Higgins.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY4, p 419-426, April, 1981. 7 Fig, 2 Ref.

Descriptors: *Performance evaluation, *Chutes, *Baffles, Spillway trough, Flow, Scour, Hydraulic structures, Hydraulic geometry.

Performance of a baffled chute, a spillway-type structure that carries water to lower elevations with relatively low terminal velocity and requires no stilling basin, was evaluated to assist design engineers. A model was developed of a baffled chute with a 90 degree bend which includes: a reach of approach channel, an upper chute, a bend, a lower chute, and a reach of outlet channel. The test program was limited to examining scour depths as a function of bend geometry. The model was operated for 30 minutes, drained, and the scoured area marked with contour lines at 1 foot intervals. The effect of bend on scour was to make it deeper and asymmetric with respect to the lower chute centerline. A simple, square 90 deg bend in a standard baffled chute carrying 40 cfs/ft increased the scour depth 0.5 ft in a 12-ft wide chute, and 2.3 ft in a 24-ft wide chute. The additional scour below the 24-ft chute may be eliminated by placing guide vanes in the bend or by lowering the bend floor. Splash beyond the bend and lower chute walls may make slope protection necessary. At least for flow rates up to 40 cfs/ft, there is no important reason based on performance why a designer should not consider a baffled chute with a bend. (Small-FRC)
W81-05263

SELF-FORMED STRAIGHT CHANNELS IN SANDY BEDS.

Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 197, No HY4, p 389-406, April, 1981. 14 Fig, 1 Tab, 16 Ref.

Descriptors: *Channel flow, *Sand, *River flow, Mass transfer, Flow, Mathematical studies, Water currents, Rivers, Hydrology, Sediments, *Channel morphology.

The process of widening and hydraulic characteristics of self-formed straight channels with noncohesive sands were studied in two laboratory flumes which were different in size. The effects of disturbances such as ripples, dunes, and meanders were excluded by conducting the experiments in idealized conditions. Corresponding to a combination of the hydraulic variables, a stable channel which allowed bed-load transport in the central bed region existed. The transverse bed shapes in equilibrium had a universal form in the side-bank region regardleess of the initial shape, the discharge, and the sand diameter. The side-bank region kept the universal shape also in the widening process and was described by an exponential function. Equilibrium depth and width were found to depend on slope and bed materials as well as discharge. Secondary currents affected the local features of the self-formed straight channels, but seemed to have no influence on the general features such as the equilibrium depth or width. A crude theoretical argument on the secondary currents was derived based on the Reynolds equations of motion. (Small-FRC)
W81-05264

ONE TECHNIQUE FOR ESTIMATING INFLOW WITH SURCHARGE CONDITIONS.
RJN Environmental Associates, Inc., Wheaton, IL.
R. J. Nogaj, and A. J. Hollenbeck.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 491-496, April, 1981. 3 Fig, 5 Tab, 2 Ref.

Descriptors: *Infiltration coefficient, *Rainfall intensity, *Sewer systems, Storm runoff, Pipe flow, Rehabilitation, Peak inflow.

A method for estimating peak inflow in a separate sanitary sewer system is based on the relationship between measured inflow at partial pipe flow and rainfall intensity. This relationship is used to estimate peak inflow caused by any rainfall event. Statistical correlation between peak inflow and rainfall intensity produces an exponential relationship, strongest when a storm duration period of less than 120 mm is used for determination of corresponding rainfall intensity. The inflow coefficient is used for determination of corresponding rainfall intensity. The inflow coefficient is smallest (0.3-0.6) for the inflow sources least sensitive to changes in rainfall intensity: foundation drains, unsealed sanitary sumps, defective service laterals, and indirect connections with storm sewers. More sensitive (0.6-1.2) were low lying manhole covers, storm sumps, manhole frame seals, and combination of direct and indirect connections with storm sewers. Highly sensitive (1.2-2.0) were downspouts, direct connections width storm sewers, and open low lying service lateral cleanouts. This technique can be used to avoid underestimating peak inflow and total flow to produce a more effective sewer system rehabilitation program. (Cassar-FRC)
W81-05277

ON SUBSURFACE DRAINAGE OF TRANSIENT RECHARGE,
National Geophysical Research Inst. Hyderabad (India).
For primary bibliographic entry see Field 4B.
W81-05308

SEPARATED FLOW THROUGH LARGE SUDDEN EXPANSIONS,
Baroda Univ. (India). Dept. of Civil Engineering.
P. R. Mehta.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY4, p 451-460, April, 1981. 11 Fig, 1 Tab, 7 Ref.

Descriptors: *Stratified flow, *Closed-conduit flow, *Turbulent flow, Flow, Experimental data, Hydrology.

Experimental findings on separated flow through large sudden expansions are presented for rectangular ducts with expansion ratios of 2.0 and 3.0. These results can be used to predict more accurately the behavior of flows through large sudden rectangular expansions. The expansion ratio was found to affect all the important parameters of the flow field. With an increase in the expansion ratio, the reattachment lengths decreased for the short stall region and increased for the long stall region. For larger expansion ratios, the flow patterns and characteristics for type 1 and type 2 flow were mirror images of each other. The rate of development of the peak values of turbulence and the rate of its decay were higher for larger expansion ratios. The Reynolds number did not influence the flow patterns. The results can be useful in designing devices in which high rates of natural mixing are desired, such as chlorine and alum injecting devices in water works. Also, a suitable mathematical model could be constructed using these results. (Small-FRC)
W81-05316

REQUIRED HEAD LOSS OVER LONG-THROATED FLUMES,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
M. G. Bos, and Y. Reinink.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR1, p 87-102, March, 1981. 9 Fig, 4 Tab, 8 Ref.

Descriptors: *Channel flow, *Flow measurement, *Flumes, Discharge coefficient, Discharge measurement, Downstream, Energy loss, Irrigation.

Trapezoidal long-throated flumes were evaluated in the laboratory as a method of measuring channel flow. The throat section was fitted with three entrance and downstream transitions. Series A tests used a concrete entrance transition, the bottom of which converged 1 to 2 and the sides, 1 to 1.5. Two downstream transitions had angles of divergence 1:0 and 1:6. Series B tests had a bottom slope 1:3 and side slope 1:2.25. Series C used a flat-bottomed flume. Conclusions were: (1) downstream transitions with a ratio of expansion of 1:1, 1:2, and 1:4 raise the the modular limit only slightly, (2) flat-bottomed flumes have a higher modular limit than flumes with an elevated throat, and (3) a downstream transition with 1:6 ratio improves the modular limit significantly in a flume with elevated throat, and an expansion only slightly improves the modular limit in a flat-bottomed flume. (Cassar-FRC)
W81-05317

HYDRAULIC DESIGN OF FLOW DISTRIBUTION CHANNELS (DISCUSSION),
West Virginia Coll. of Graduate Studies, Institute.
C. L. Swanson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE2, p 432-433, April, 1981. 1 Tab.

Descriptors: *Hydraulic design, *Flow channels, *Orifice flow, Hydraulic engineering, Froude number, Flow rates, Suspended solids, Weirs.

Observations of a rectangular sedimentation tank design where the flow entered through the center ports and recirculated back through the ports at the sides of the tank led to the development of a method of hydraulic design of flow distribution channels. Approximate methods are presented for solving the Camp and Graber equation for orifices. A step method can be used to estimate the head and flow at other weirs once the flow and average head at Weir 6 have been estimated. The Froude number is not considered, but this appears to compensate for the errors introduced by the step method. A flow distribution method that has good application for flow containing suspended solids is a rectangular opening extending the full depth of the channel with tank water surface elevation established so critical depth occurs at all flow rates. (See W80-05947). (Small-FRC)
W81-05324

8C. Hydraulic Machinery

RELIABILITY OF IRRIGATION SYSTEMS,
Grundfos A/S (Denmark).
M. Ellegaard.
Aqua, No 1, p 28, 30-31, 1981. 2 Fig.

Descriptors: *Irrigation design, *Developing countries, *Electrical equipment, Irrigation engineering, Performance evaluation, Pumps, Irrigation systems.

In the past, irrigation efforts in developing countries have concentrated on areas surrounding natural occurrences of water, where the water could be pumped and distributed with very primitive aids. However, more sophisticated methods are required to convert deserts to arable land. Not only are electrical pumps absolutely necessary to draw water from the deep water table, but distribution must be accomplished through pipe systems, irrigation machines, or sprinklers. Several points should rule the selection and provision of irrigation systems in developing countries. The maintenance and repair costs of the irrigation system should be kept as low as possible by paying special attention to both construction quality and materials selection. The irrigation system should be sturdy, simple, and easy to operate. The reliability of the system is especially important in these areas, where a few days without irrigation can result in substantial crop losses. The system must be able to operate independently of any public electricity supply system. The whole irrigation system should be bought from one supplier in order to ensure that the system is designed and engineered for the particular situation and to permit all subsequent problems to be directed to one supplier. The supplier should take full responsibility for training local users and service personnel, supervision of the installation and start-up of the system, and providing a guarantee for the installed system as a whole. Some technical details with respect to pumps, prime movers, automatic control equipment, and distribution of water to the fields are discussed. (Carroll-FRC)
W81-05239

TRICKLE IRRIGATION: EMITTER CLOGGING AND OTHER FLOW PROBLEMS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
R. G. Gilbert, F. S. Nakayama, D. A. Bucks, and O. F. French.
Agricultural Water Management, Vol 3, No 3, p 159-178, 1980/1981. 7 Fig, 7 Tab, 17 Ref.

Descriptors: *Trickle irrigation, *Flow characteristics, *Clogging, Flow rates, Irrigation, Agriculture, Arizona, Water treatment, Filtration, Chemical treatment, Suspended solids, Water conveyance.

Emitter clogging is the greatest problem of the trickle irrigation systems which are used to deliver water to row and tree crops. A comprehensive four-year study was conducted to develop water treatment methods for preventing emitter clogging and maintaining long-term operation of the trickle irrigation system under actual field conditions. The study evaluated eight trickle emitter systems in combination with six water treatments using Colorado River water in southwestern Arizona. Emitter clogging was found to be related to emitter design and to the degree of filtration treatments of the river water. Only the long-path, spiral-grooved, manual flush emitter design performed efficiently with only screen filtration. Although the expandable diaphragm emitter never developed clogging problems, it failed because of increased flow rates caused by eight reactions with the chemically conditioned water or physical and biological decomposition of the flexible rubber diaphragm. The automatic flushing emitters were most susceptible to malfunction and clogging problems, especially if they were not installed verticaly on the lateral lines. For emitters unaffected by material deterioration, the continuous acid treatment alone was just as effective in reducing emitter clogging as a combination of continuous or intermittent chlorine and acid treatments. The domi-

nant cause of emitter clogging and flow reduction was physical factors. The combined development of biological and chemical deposits was the second, relatively minor, cause of these problems. The major physical factors involved were sand grains and plastic particles. Care should be taken to avoid the introduction of these particles into the lines during installation and repair. (Carroll-FRC)
W81-05253

THE DECADE--A MANUFACTURERS VIEW,
Grundfos A/S (Denmark).
S. Noregaard.
Aqua, No 1, p 27-28, 1981. 2 Fig.

Descriptors: *Developing countries, *Pumps, *Mechanical equipment, Electrical equipment, *Hydraulic equipment, Needs assessment, Training, International hydrological decade.

The United Nations' Water Supply and Sanitation Decade will stimulate international funding organizations to make investments to improve the availability of potable water in developing countries during the 1980s. A substantial part of this investment will go to small communities in rural areas where ground water is the only available water source. These funds should be spent with emphasis on both the immediate and the future needs of each individual society. Manufacturers must provide only equipment of the highest possible standard of workmanship, durability, and reliability in service. Under tropical conditions, a break of even a few days in irrigation could result in substantial crop damage. Consultants and suppliers must accept responsibility for specifying systems which can operate within the capabilities of the society which they will serve, but which also provide room for growth. Hand operated pumps, for instance, provide no room for further development, while an electrically operated or diesel driven submersible pump provides the basis of a system which could later be extended to provide water for irrigation or for industry. Education and training provide the real key to the long-term success of the Decade. Training programs, including both training within the manufacturing plant and on-site training when equipment is installed, must be adjusted to meet the particular needs and wishes of the countries involved. Training programs should combine the use of pictorial materials containing a minimum of text with practical hands-on experience. (Carroll-FRC)
W81-05336

8D. Soil Mechanics

ROLE OF TRENCH BACKFILL IN SUBSURFACE DRAINAGE-A REVIEW.
Department of Agriculture, Columbus, OH, Soil Drainage Research Unit.
For primary bibliographic entry see Field 4A.
W81-05126

8F. Concrete

THE USE OF CLAY-CEMENT FLY-ASH DEFORMABLE BACKFILL GROUTS FOR SEWER TUNNELS,
R. G. H. Boyes.
Water Services, Vol 84, No 1013, p 413-414, 417, July, 1980. 3 Fig, 4 Ref.

Descriptors: *Grouting, *Mortar, *Maintenance, Sewer systems, Cements, Sewerage, Clays, Fly ash.

A deformable backfill grout for sewer tunnels was developed using a synthetic clay, cement, fly-ash, and water. The mix was eventually factory produced and used successfully in several London tunnels. Tests and data from a variety of sources indicate that with neat cement mortar mixes the compressive strength lies at a value 8 to 10 times the tensile strength. This strength ratio then decreases with an increase in the clay proportion until the cement:clay ratio is 3:1 and compressive strength is about 3 times tensile strength. When using cement mixes with phosphorus-fly ash additions, sedimentation was decreased provided the phosphorus-fly ash content was a minimum of 20% by weight. While the synthetic form of natural hectorite clay or bentonite clay is usually used, low liquid limit clays such as ball clay give fairly good results. Ball clays have worked particularly well when mixed with seawater and the grout has been pumpable up to 100 m. Clay-phosphorus-fly ash-cement mixes are a considerable improvement over ordinary cement grouts. (Small-FRC)
W81-05314

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